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REPORT NO. EMT 26 - 87

RAIL TRANSPORTABILITY TEST
OF THE
REMOTELY PILOTED VEHICLE
(RPV)
SYSTEM

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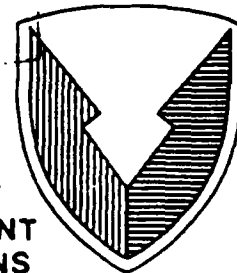
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20. (continued)

Assembly of the RPV System were each blocked, braced, and tied down on a railroad flatcar. After each unit of the RPV System was rail impacted, the unit was operationally tested within the RPV System.

The method of blocking, bracing, and tying down each item was approved for rail transport. The shock loads resulting from the rail impacts were not detrimental to the operation of the equipment.

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*****ABSTRACT*****

The U.S. Army Defense Ammunition Center and School (USADACS) conducted a transportability test of the Remotely Piloted Vehicle (RPV) System at the request of the U.S. Army Missile Command (MICOM) and to satisfy requirements of the Military Traffic Management Command (MTMC), Transportation Engineering Agency (TEA), and USADACS. The transportability test consisted of a rail impact test in which the maintenance shelter, the ground control station, the air vehicle handler, the launch assembly, the remote ground terminal and the recovery assembly of the RPV System were each blocked, braced, and tied down on a railroad flatcar. After each unit of the RPV System was rail impacted, the unit was operationally tested with the RPV System.

The method of blocking, bracing, and tying down each item was approved for rail transport. The shock loads resulting from the rail impact were not detrimental to the operation of the equipment.

U.S. Army Defense Ammunition Center and School
Savanna, IL 61074-9639

REPORT NO. EVT 26-87

Rail Transportability Test of the Remotely Piloted Vehicle (RPV) System

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PART I

GENERAL

A. INTRODUCTION:

The U.S. Army Defense Ammunition Center and School (USADACS) was requested to conduct a transportability test of the Remotely Piloted Vehicle (RPV) System. The blocking, bracing, and tiedown procedure for each item of the RPV was designed by the commercial systems contractor. USADACS tested each item by securing it to a railroad flatcar and rail impact testing the item.

We also performed static pull tests on slinging and tiedown provisions on the launch assembly and recovery assembly.

B. AUTHORITY:

Testing was accomplished in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM). Reference is made to the following:

1. Change 4, 4 October 1974, to AR 740-1, 23 April 1973, Storage and Supply Activity Operations.
2. AMCCOM-R 10-17, 13 January 1986, Mission and Major Functions of USADACS.
3. Message, USAMICOM, AMCPM-RP-T, 071314Z Feb 87, subject: Remotely Piloted Vehicle (RPV) Aquila Rail Impact Test.

C. OBJECTIVE:

The primary objective of this test was to establish that the blocking, bracing, and tiedown method designed for the RPV System loaded on a railroad flatcar was adequate to safely secure the items and eliminate damage to the items when subjected to the Association of American Railroads (AAR)

rail impact test criteria. Other objectives of this test were to determine the response of the RPV items to shock loads and the affect of static pulls on the slinging and tiedown provisions on the RPV system.

D. CONCLUSIONS:

The Maintenance Shelter, Ground Control Station, Air Vehicle Handler, Launch Assembly, Remote Ground Terminal and Recovery Assembly of the RPV System were each separately loaded, blocked, braced, and tied down on a railroad flatcar equipped with a non-cushioned (standard) draft gear. The loaded flatcar was rail impacted and the results met the AAR test parameters, and MIL-STD-810 rail impact test criteria. The equipment necessary for an operational check was tested following the rail impact and found to be functional.

E. RECOMMENDATIONS:

It is recommended that all items secured to the Launch Assembly and Recovery Assembly be secured with 3/4-inch or 1-1/4-inch wide metal banding replacing the 1/2-inch wide banding used in testing.

It is recommended that the blocking and bracing and wire rope tiedown method tested be used for preparation of the AMC 19-48 series carloading drawings for railcar shipment of the RPV System.

PART II

LIST OF ATTENDEES

Transportability Test, 15 April - 2 May 9C7

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PART III

RAIL IMPACT TEST PROCEDURES

A. RAIL IMPACT TESTING:

Rail impact testing was accomplished in compliance with previously approved and standardized testing procedures as shown on Page III-3 and described as follows:

1. The 'Specimen Car' was scheduled to be impacted four times; three times at speeds of 4, 6, and 8 mph in one direction, and one time at 8 mph in the opposite direction. The latter two impacts cited are minimum speed requirements.

2. Impacting was accomplished by striking the test car (specimen car) into a line of five stationary cars (buffer cars). The buffer cars were coupled with all connecting draft gears compressed together to the maximum extent possible under prevailing conditions, with all air brakes in a 'set' position.

3. A locomotive (switch engine) was utilized to start the test car rolling in the direction of the buffer cars along an approximate 800-foot segment of level trackage.

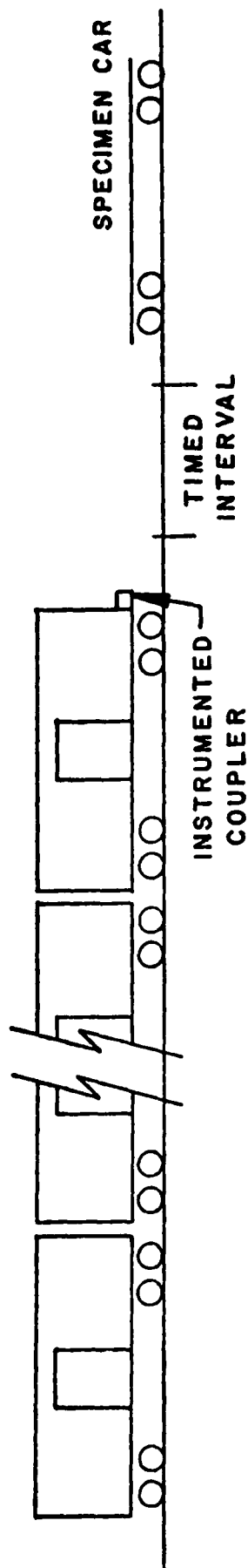
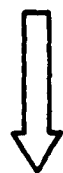
4. The test car was cut loose from the engine approximately 75 feet from the point of impact and allowed to roll freely into the first of the buffer cars.

5. Impacting speeds were determined by the utilization of an electronic counter which measured the time required for the test car to traverse an 11-foot distance immediately prior to impact; recorded elapsed time was converted to mph speeds. Additional verification of impacting speeds was accomplished by utilization of an electronic stop clock.

B. INSPECTIONS AND DATA COLLECTION:

At selected intervals during testing, thorough inspections of the specimen load were made by technically proficient personnel to collect data on the specimen load and equipment resulting from impacts. These data are recorded in Part IV following.

ASSOCIATION OF AMERICAN RAILROADS (AAR) STANDARD TEST PLAN



5 BUFFER CARS WITH DRAFT GEAR
COMPRESSED AND AIR BRAKES IN
A SET POSITION

BUFFER CAR TOTAL WT 251,000 LBS (APPROX)

SPECIMEN CAR
IS RELEASED BY
SWITCH ENGINE AT:
IMPACT NO. 1 4 MPH
IMPACT NO. 2 6 MPH
IMPACT NO. 3 8 MPH
THEN CAR IS REVERSED
AND RELEASED AT
IMPACT NO. 4 8 MPH

PART IV
TEST SPECIMEN AND RESULTS

MAINTENANCE SHELTER

SYNOPSIS OF TEST

The Maintenance Shelter was loaded on a 52-foot long railroad flatcar equipped with noncushioned (standard) draft gear, and with a complete wooden plank floor. The door end of the Shelter was facing the 'A' end of the flatcar. The Shelter was blocked and braced with 2-inch X 10-inch wooden planks and cabled with 5/8-inch diameter wire rope. The method of securement was furnished by the system contractor.

Accelerometers measuring vertical and longitudinal forces with the force duration were mounted on the floor of the railroad flatcar, equipment rack (inside shelter), aviation pedestal (inside shelter), air conditioner mount and center of gravity of the container.

The shelter was rail impacted at 4, 6, 8, and reverse 8 mph, per the Association of American Railroads (AAR) and MIL-STD-810 rail impact test criteria. Following the 6 mph impact, inspection revealed a slight lifting of the top 3 layers of 2-inch X 10-inch planks of the header on the impacted end of the Shelter. The Maintenance Shelter's skid was being forced between the layers of planks in the header.

The system contractor's drawing did not specify 5/8-inch thimbles under the wire rope where the wire rope passes over an edge of a railroad flatcar stake pocket and the tiedown provisions on the Shelter. Although no damage occurred to the wire rope, it is recommended that the thimbles be used at stake pockets and Shelter tiedown provisions.

The Maintenance Shelter including interior components sustained no damage and the securement method remained in an acceptable condition during exposure to the rail mode of transportation.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 1

LOAD NO. 1

DATE: 15 April 1987

SPECIMEN LOAD: Maintenance Shelter of the Remotely Piloted Vehicle System
loaded on a railroad flatcar.

TEST FLATCAR NO. SP&S 34094 LT. WT. 47,200 Lbs.

REFERENCE LOAD NO. 1 WT. 5,724 Lbs.

TOTAL SPECIMEN WT. 52,924 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	B	4.10	No significant movement.
2-A	B	6.19	Slight lifting of 2-in X 10-in planks in headers where Maintenance Shelter skid being forced between planks.
3-A	B	8.00	No significant movement.
4-B	A	8.04	No significant movement.

RAIL IMPACT TEST DATA

DATE: 15 April 1987

C.G. OF CONTAINER

VERT : LONG ; VERT

[illegible]

1	4.50	170.000	1.25	12.50	1.36	100.0	0.80	12.5	1.60	75.0	1.50	12.5	2.45	75.0	2.50	100.0	1.25	62.5
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2	:6.19	:290	000	:2.15	:12.50	:1.96	:125.0	:1.10	:25.0	:0.75	:100.0	:0.55	:12.50	:2.20	:100.0	:0.3.25	:62.5	:4.00	:25.0	:1.45	:62.5
---	-------	------	-----	-------	--------	-------	--------	-------	-------	-------	--------	-------	--------	-------	--------	---------	-------	-------	-------	-------	-------

3	:8	00	:390	000	:	2	.13	:	13	00	:	3	.29	:	75	0:	1	.25	:	50	0:	1	.70	:	25	0:	0	.50	:	50	00	:	4	.40	:	62	.5	4	.88	:	50	0:	6	.50	:	125	0:	12	.70	:	75	0:
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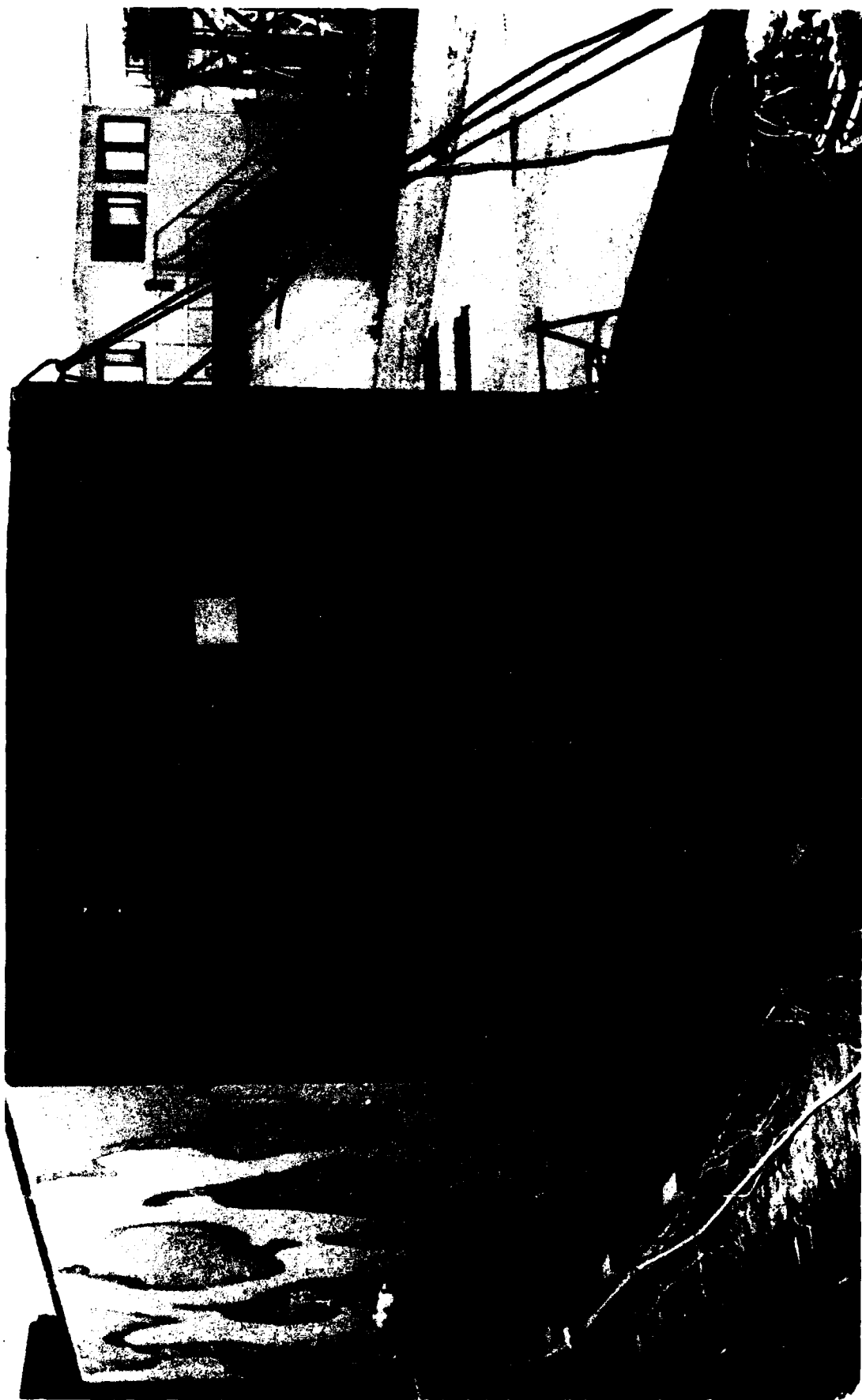
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DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

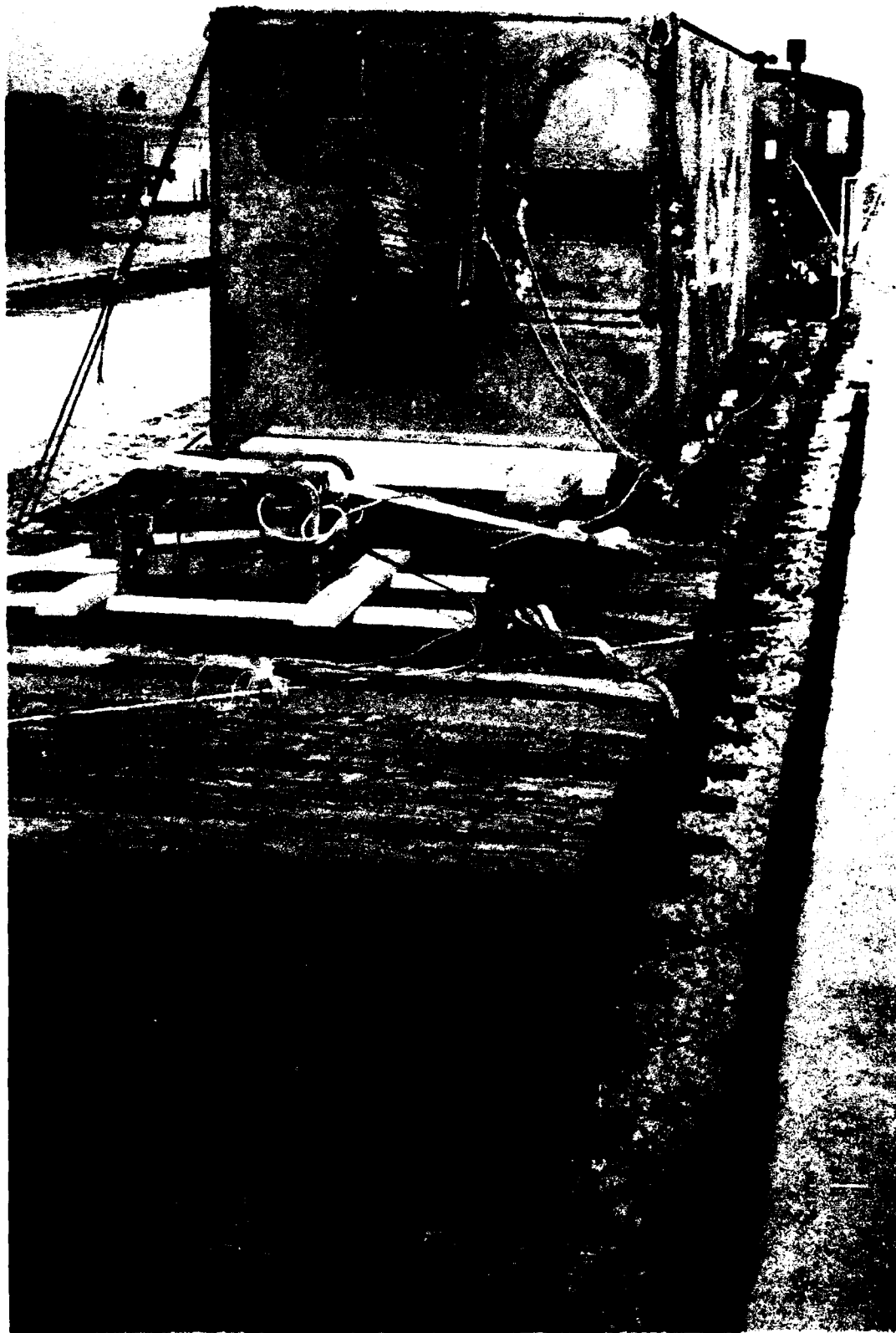
View of the Maintenance Shelter blocked, braced, and tied down on a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of the entrance (A) end of the Maintenance Shelter. Note instrumentation package and signal carrying cables exiting the upper right-hand corner of the Shelter.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of the enclosed end of the Maintenance Shelter. Generator mounted on flatcar deck supplied power to contractor's instrumentation. Note accelerometer on railcar floor, air conditioner mount and center of gravity on side of Shelter.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

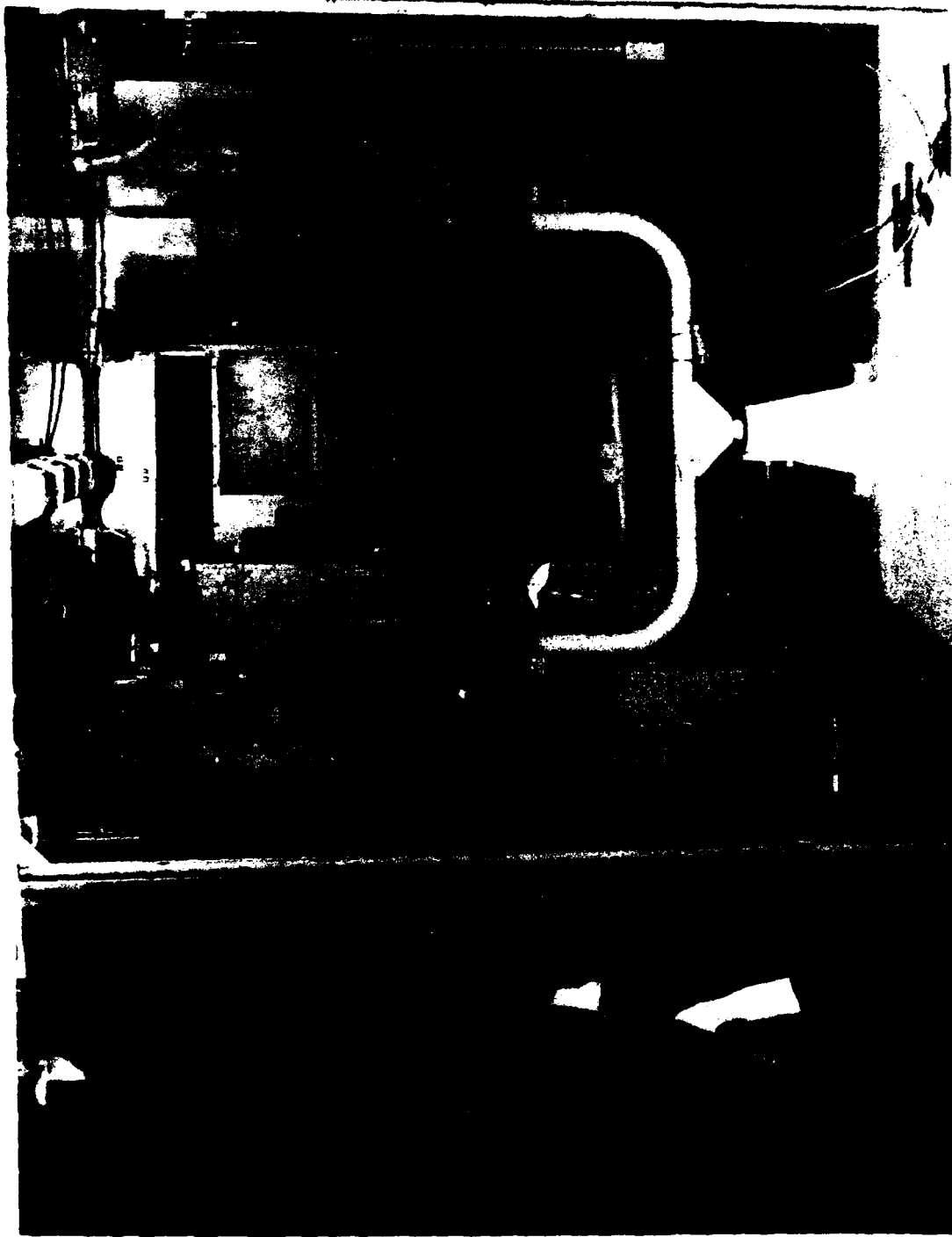
View of wire rope thru tiedown ring and wooden header with backup cleat. Note the absence of thimbles under the wire rope at the tiedown ring.



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Photo No. 5

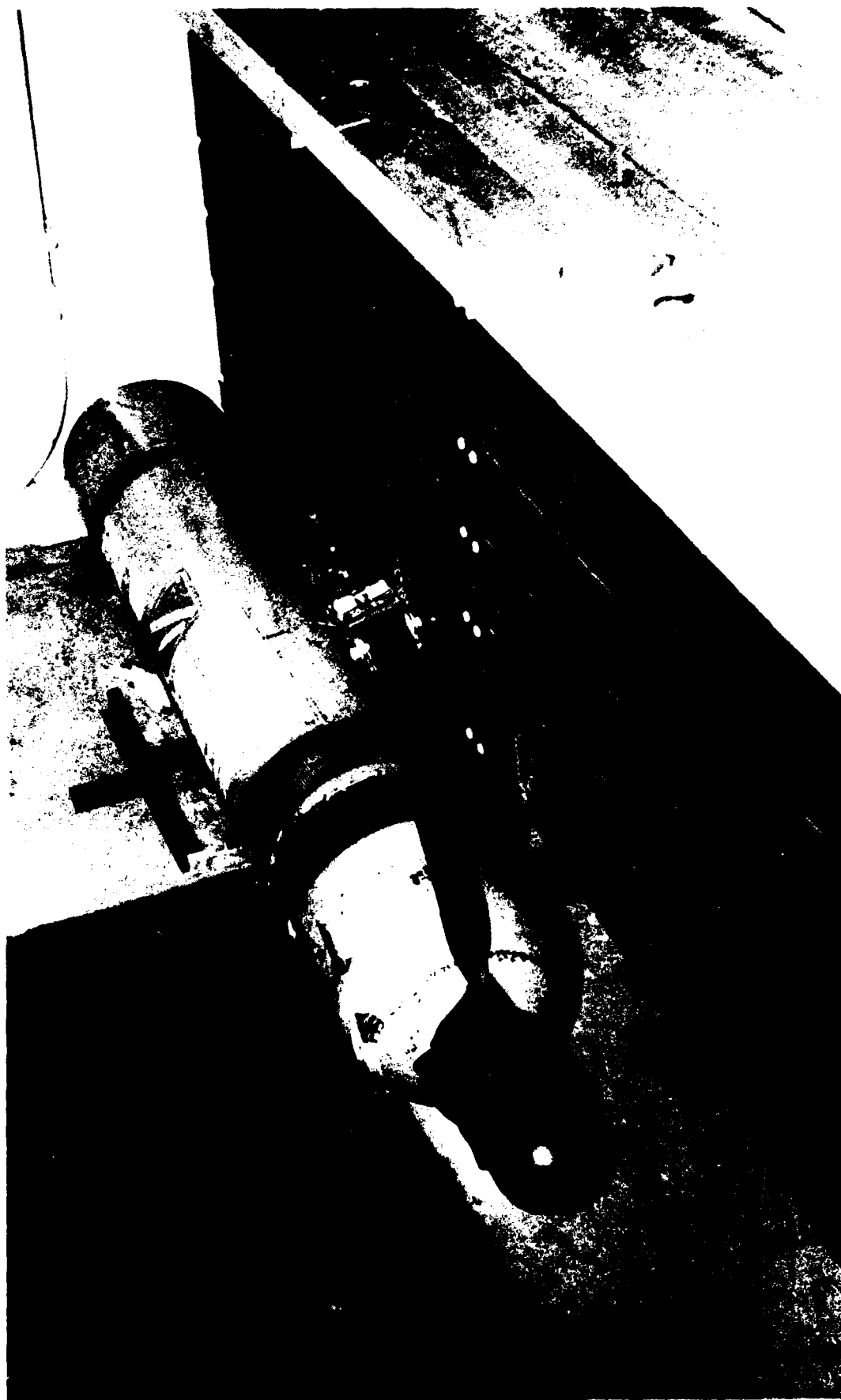
View of wire rope thru slinging ring on top of Maintenance Shelter. Note the absence of thimble under the wire rope at the slinging provision.



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Photo No. 6

View of Maintenance Shelter interior showing secured items. Note accelerometers mounted on equipment rack and aviation pedestal.



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Photo No. 7

View of nitrogen tank and the method of securing.



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Photo No. 8

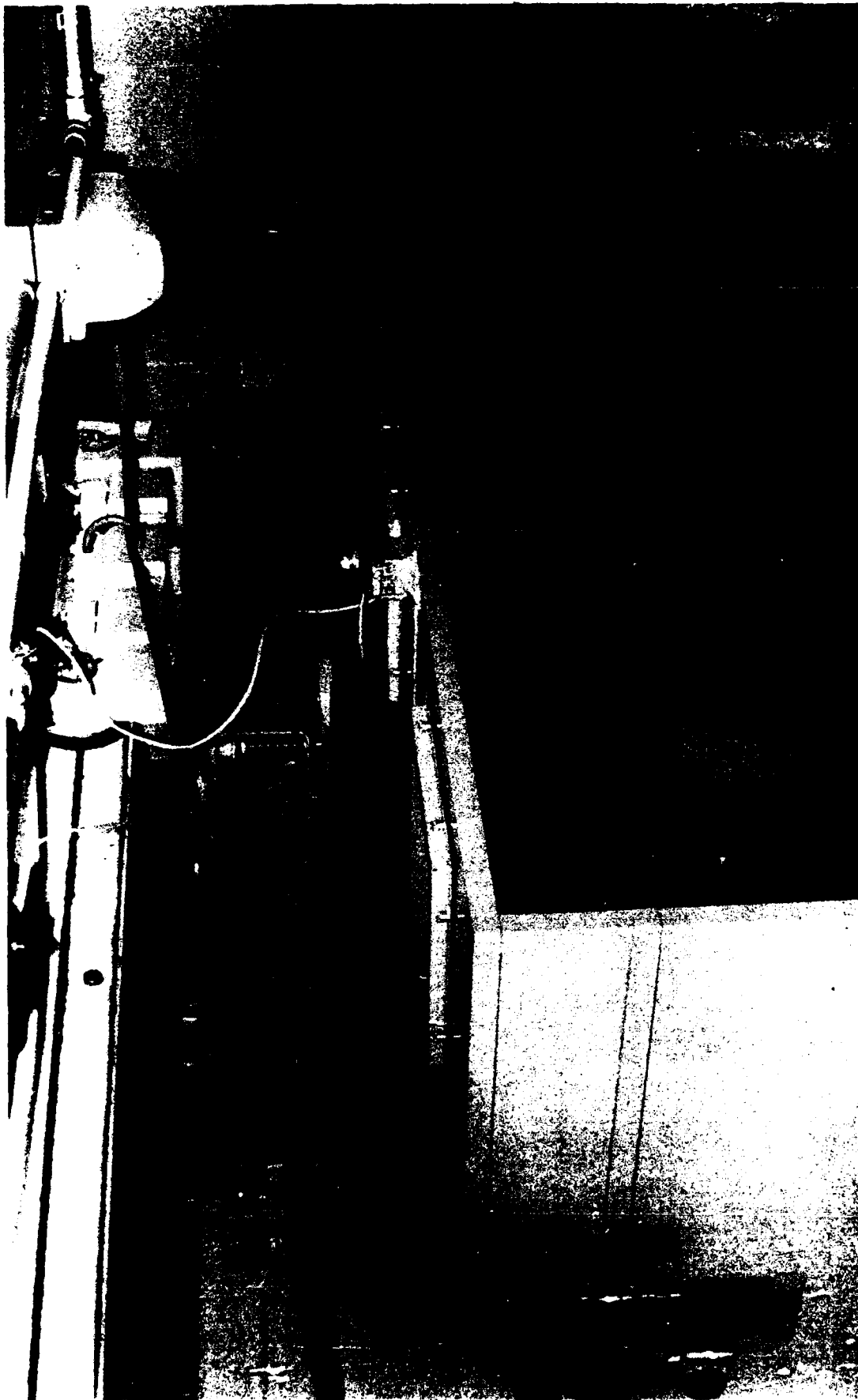
View of portion of equipment rack and case including method of securement.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 9

View of accelerometers mounted on deck floor of railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 10

View of accelerometers mounted on the equipment rack inside the Maintenance Shelter.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 11

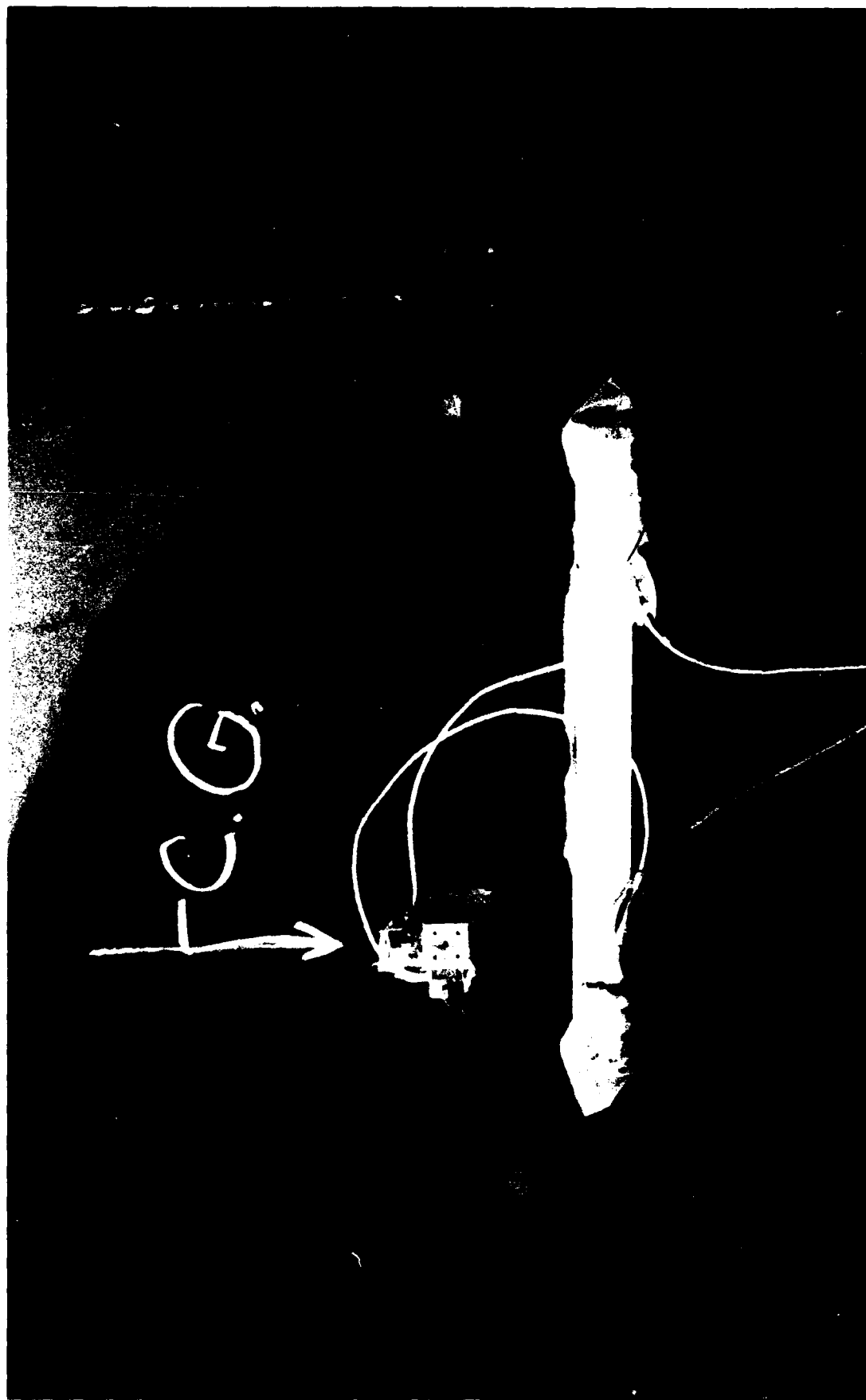
View of accelerometers mounted on the aviation pedestal inside the Maintenance Shelter.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 12

View of accelerometer mounted on the air conditioner mount.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 13

View of accelerometer mounted at the center of gravity on side of Maintenance Shelter.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 14

End view of header following 6 mph impact showing lifting of the wooden planks.

GROUND CONTROL STATION

SYNOPSIS OF TEST

The Ground Control Station (GCS) was loaded on a 54-foot long railroad flatcar equipped with noncushioned (standard) draft gear. The railroad flatcar floor was composed of 5-1/2-inch wide wooden planking alternating with a 5-1/2-inch wide steel channel positioned laterally on the floor of the flatcar. With the GCS centered on the flatcar, the headers fell on the 5-1/2-inch wide steel channel which prohibited nailing the header to the car floor. The GCS was moved 4 inches off center to permit nailing of the headers into the 5-1/2-inch wide wooden plank. The GCS was blocked and braced with 2-inch X 10-inch wooden planks and tied down with 5/8-inch diameter wire rope. The system contractor furnished a plan of the securement method.

Vertical and longitudinal forces were measured from accelerometers mounted on the floor of the railroad flatcar, disk drive, control monitor group, air vehicle display and center of gravity of the GCS. The longitudinal measuring accelerometer on the bed of the railroad flatcar malfunctioned during this test and no data was obtained.

The GCS was rail impacted at 4, 6, 8 and reverse 8 mph per AAR and MIL-STD-810 rail impact test criteria. The total accumulated movement in either the forward or reverse rail impacts was less than 1/2-inch.

The GCS, including the interior electrical control units, was not damaged, and the tiedown method successfully restrained the GCS during the rail impact.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 2

LOAD NO. 2

DATE: 16 April 1987

SPECIMEN LOAD: Ground Control Station of the Remotely Piloted Vehicle
System loaded on a railroad flatcar

TEST FLATCAR NO. GN 60270 LT. WT. 53,700 Lbs.

REFERENCE LOAD NO. - - WT. 8,956 Lbs.

TOTAL SPECIMEN WT. 62,656 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	A	4.60	Moved 1/8-inch forward.
2-A	A	6.00	No movement.
3-A	A	8.04	Moved additional 1/4-inch forward.
4-B	B	8.06	Moved rearward 3/8-inch.

GROUND CONTROL STATION

DATE: 16 APRIL 1987

RAIL IMPACT TEST DATA

RAILCAR	:	DISK DRIVE	:	CONTROL MONITOR GROUP :	AIR VEHICLE DISPLAY :	CG OF CONTAINER
	:		:		(UNDER CONSOLE)	

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: COUPLER:  VERT : LONG : VERT : LONG : VERT : LONG : VERT : LONG : VERT : LONG :
IMPACT: SPEED: FORCE : DUR: FORCE: DUR: FORCE: DUR: FORCE: DUR: FORCE: DUR: FORCE: DUR:
NO. : (MPH) : (LBS.): GS : MS: GS : MS: GS : MS: GS : MS: GS : MS: GS : MS: GS : MS: GS : MS: GS : MS: GS :

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1	4.60	200,000	2.40	25.00	3.45	125.0	0.56	25.00	1.08	100.00	1.35	25.00	3.75	100.0	3.20	12.50	2.90	100.0	1.30	75.00
2	6.00	172,000	1.88	13.00	2.00	125.0	0.54	25.00	0.90	12.50	0.25	12.50	2.25	125.0	2.80	12.50	2.25	150.0	0.80	12.50
3	8.04	320,000	1.94	25.00	7.50	100.0	2.50	50.00	1.50	100.00	1.20	2.50	7.80	75.0	5.80	12.50	5.40	062.5	2.15	175.00
4	9.06	200,000	1.50	13.00	5.63	100.0	1.70	50.00	2.75	100.00	1.93	12.50	7.26	100.0	6.50	81.25	5.70	125.0	1.95	62.50

4	0.06	200	0.00	1.93	12.50	7.26	100.0	6.50	81.25	5.70	125.0	1.95	62.50
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DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

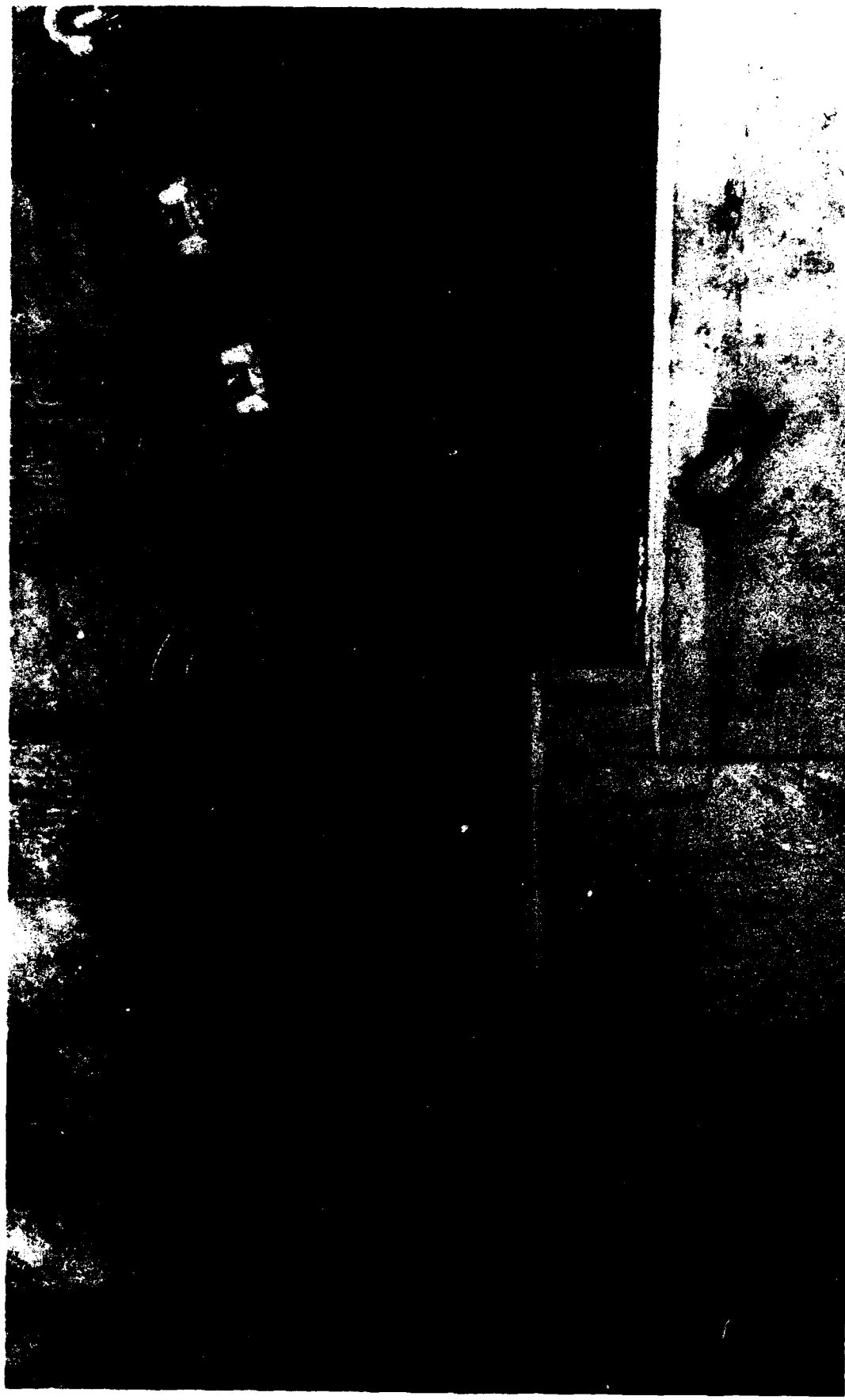
View of Ground Control Station secured to a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of instrumentation package and end of the Ground Control Station.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of tiedown ring on base of Ground Control Station.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

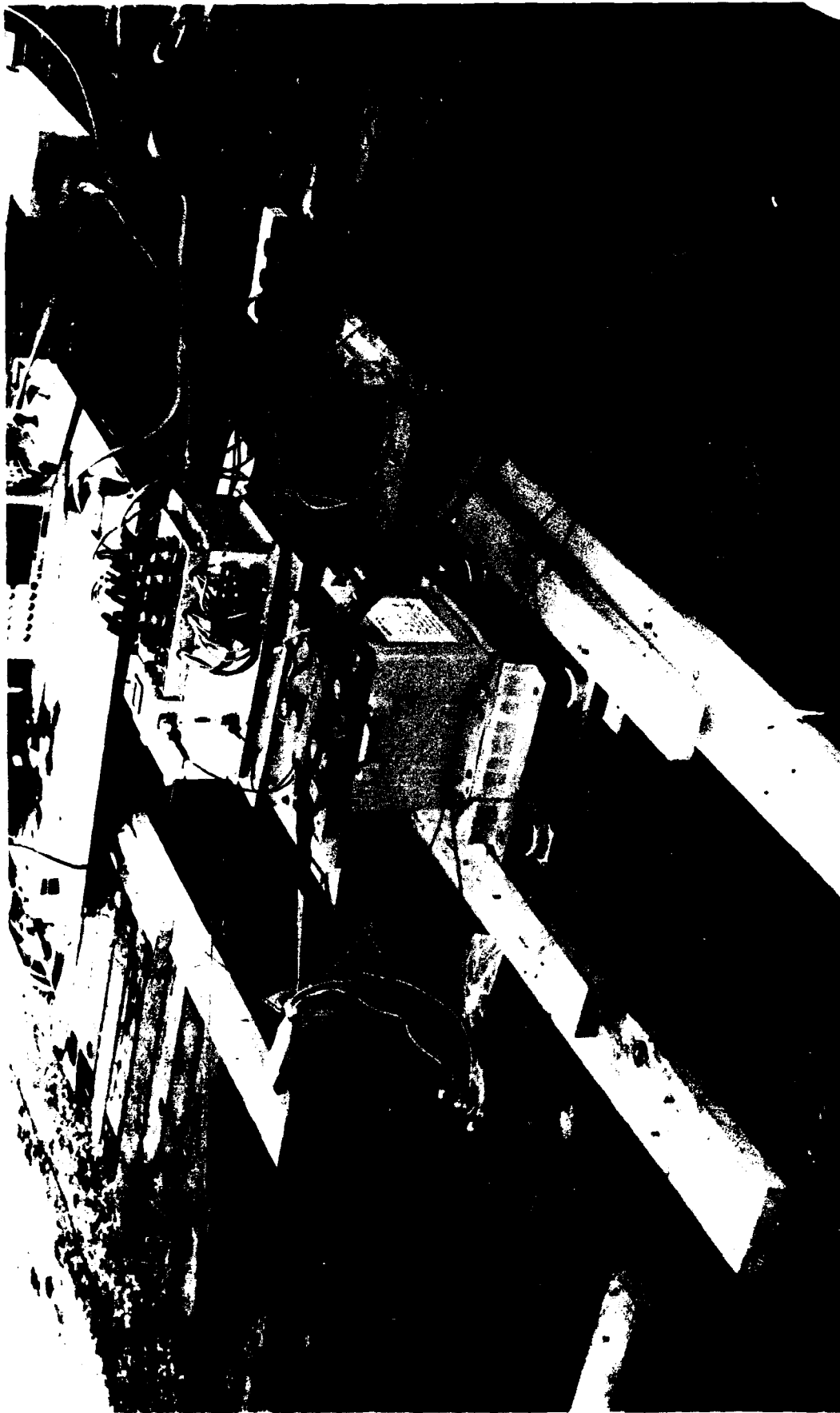
View of tiedown ring on top of Ground Control Station.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

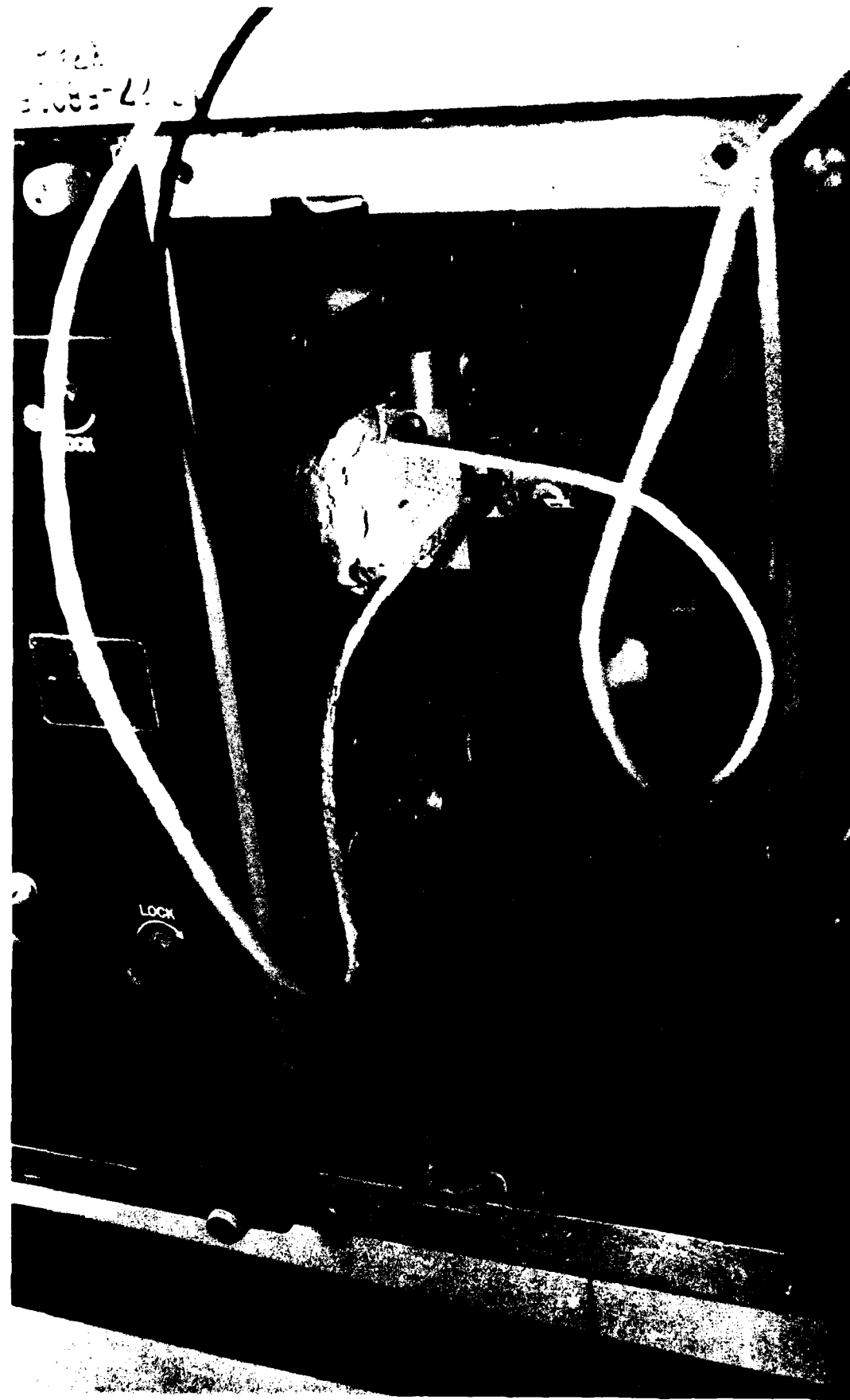
View looking into the doorway of the Ground Control Station.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 6

View of accelerometer on the railroad flatcar floor adjacent to the instrumentation package.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 7

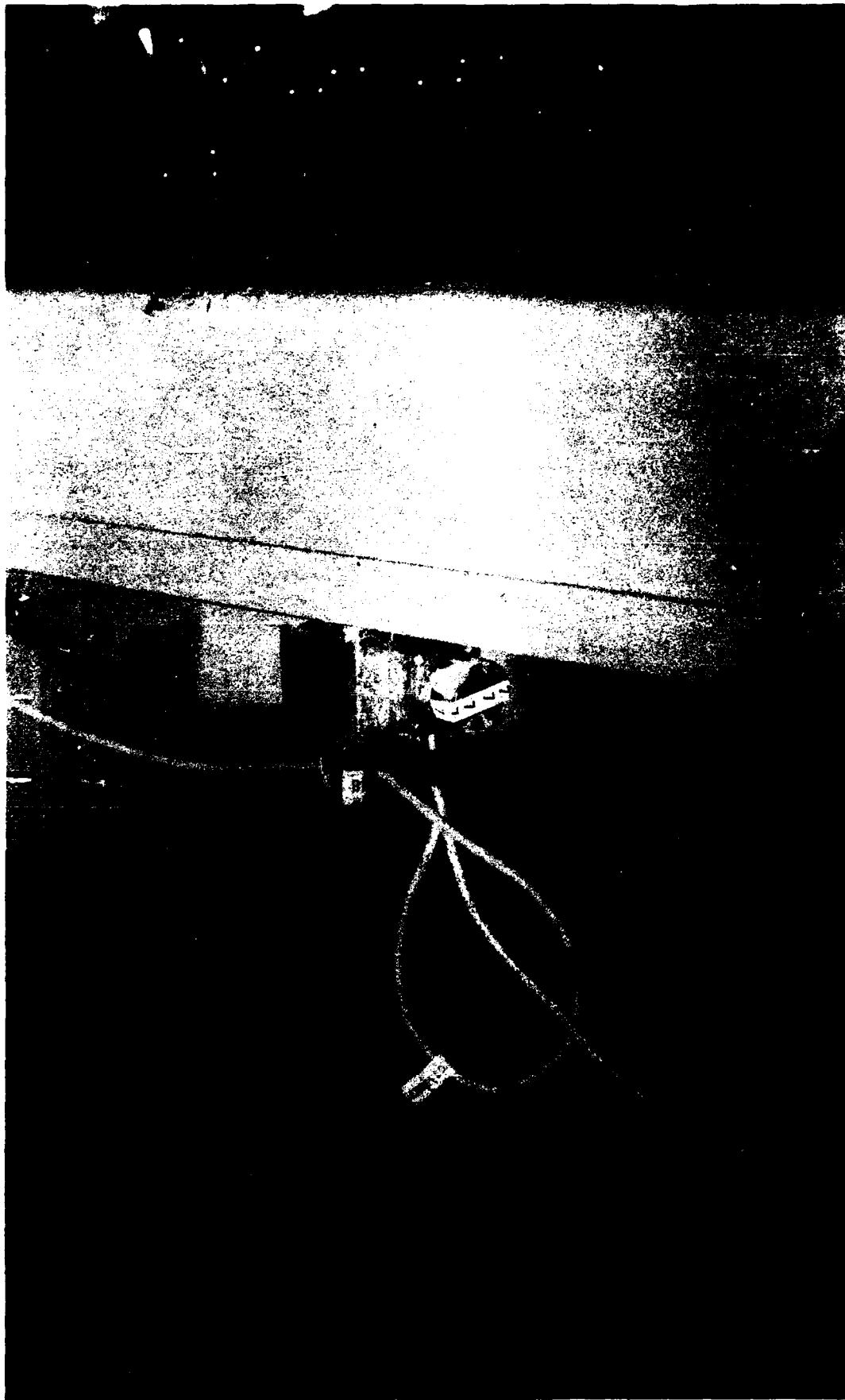
View of accelerometer on the disk drive.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 8

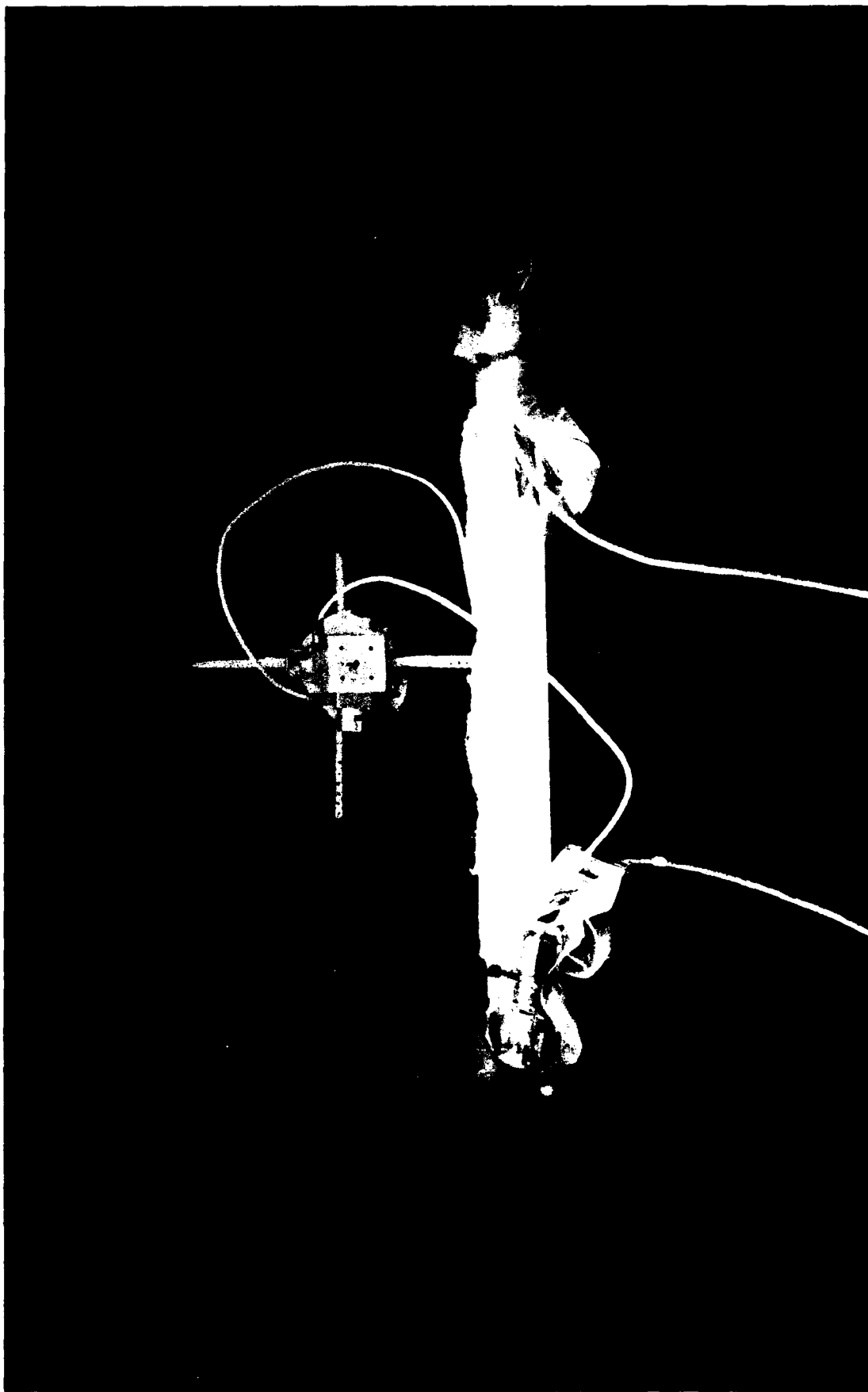
View of accelerometer on the control monitor group.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 9

View of accelerometer on the Air Vehicle display (under console).



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 10

View of accelerometer at center of gravity on the side of the Ground Control Station.

AIR VEHICLE HANDLER
SYNOPSIS OF TEST

The purpose of this Air Vehicle Handler (AVH) rail impact test was to simulate the AVH and the Air Vehicle (AV) so as to obtain, thru instrumentation, the expected loads induced on the AV.

A 5-ton cargo truck was substituted for the AVH and three Air Vehicle Containers were positioned in the cargo bed of the 5-ton cargo truck to simulate the actual load of two Air Vehicle Containers and the truck crane. The middle of the three containers loaded on the 5-ton cargo truck contained the instrumented dummy AV.

The 5-ton cargo truck was blocked and braced and cabled to the all-wooden floor railroad flatcar per a previously approved tiedown procedure. Web strap tiedown assemblies were used to secure the three Air Vehicle Containers to the cargo bed of the 5-ton truck.

Following the 4 mph rail impact, two additional web strap tiedown assemblies were added to restrain the middle container with the AV inside. Evaluation of the instrumentation test data from this rail impact test with the dummy AV validated that forces were at a magnitude that the AV could safely withstand.

Based on this engineering test, a rail impact test with the actual AV on the AVH can be performed without inflicting damage to the AVH.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 3

LOAD NO. 3

DATE: 20 April 1987

SPECIMEN LOAD: 5-Ton Cargo Truck (simulating the Air Vehicle Handler)
containing three Air Vehicle Containers.

TEST FLATCAR NO. SP&S 34094 LT. WT. 47,200 Lbs.

REFERENCE LOAD NO. 3 WT. 32,383 Lbs.

TOTAL SPECIMEN WT. 79,583 Lbs.

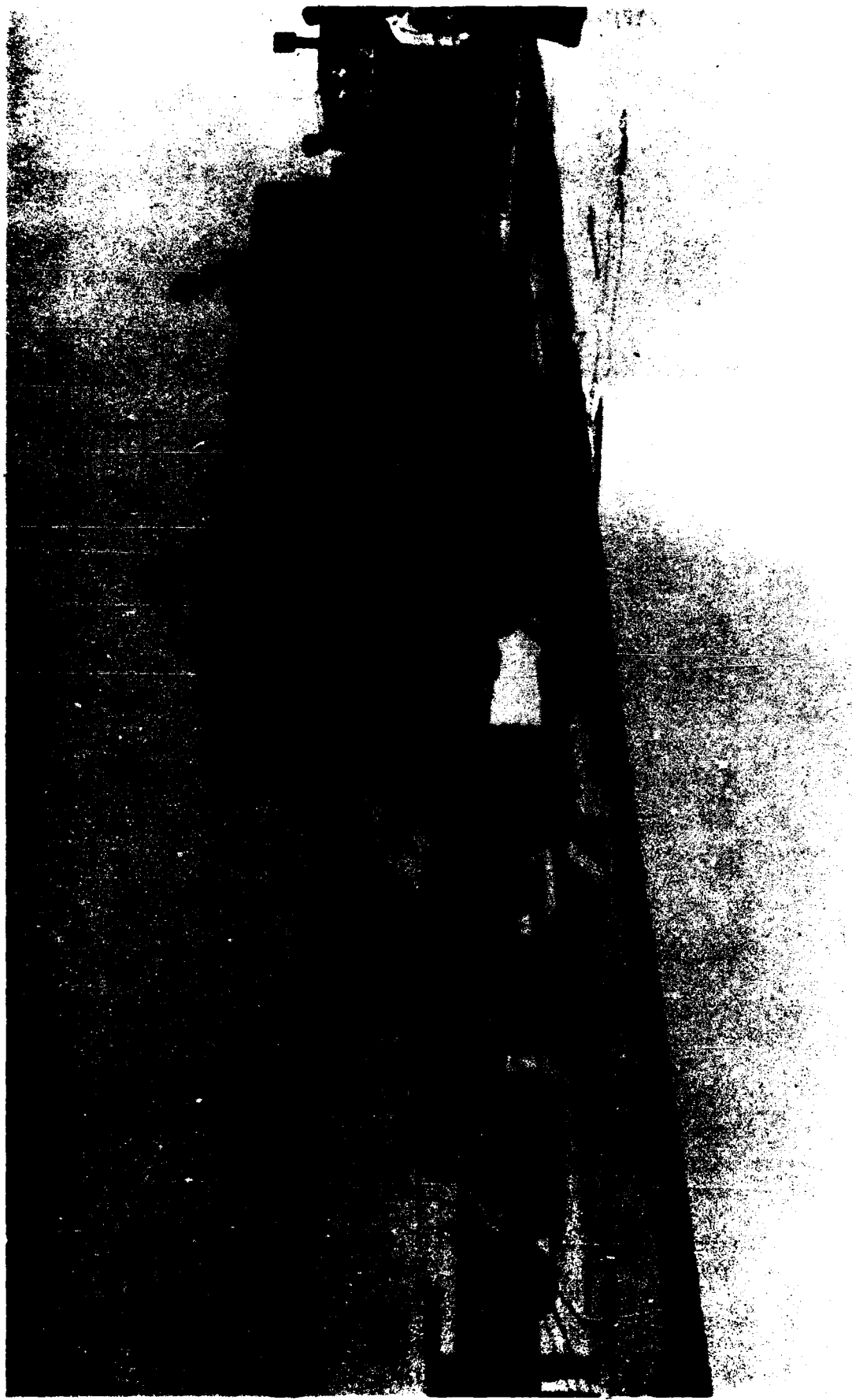
BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	A	4.70	Middle Air Vehicle Container moved forward 2 plus inches and rebounded 2 inches.
2-A	A	6.13	Middle Air Vehicle Container moved forward and rebounded an additional 3/4 inch.
3-A	A	8.07	Middle Air Vehicle Container moved forward and rebounded an additional 1/4 inch.
4-B	B	8.16	Middle container moved rearward in the truck and rebounded 2-1/8 inches.

RAIL IMPACT TEST DATA

DATE: 20 April 1987

RAIL IMPACT TEST DATA



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

View of the 5-ton cargo truck loaded with three Air Vehicle Containers. Middle container of the load contained the instrumented dummy Air Vehicle.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of accelerometer mounted on side rail connector of the dummy Air Vehicle.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of accelerometer placed on Air Vehicle structure near center of gravity.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

View of accelerometer secured to the engine of the Remotely Piloted Vehicle.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

View of accelerometer placed on the Air Vehicle container base, vertical.

LAUNCH ASSEMBLY

SYNOPSIS OF TEST

The Launch Assembly (LA) was removed with a mobile crane from the chassis of the 5-ton cargo truck and placed at the center of the railroad flatcar. The floor of the railroad flatcar was composed of wooden planking and steel channel alternately positioned across the flatcar.

The system contractor's restraint procedure included 2-inch X 10-inch lumber for blocking and 5/8-inch diameter wire rope for tie down. Several items, including a removable ladder and a set of mudflaps from the 5-ton cargo truck, were secured to the base of the Launcher with 1/2-inch wide metal banding.

During the three forward impacts, the accumulated movement of the ladder was 2-1/2-inches and the accumulated movement of the mudflaps was 1-1/4-inches. The 8 mph reverse impact caused failure of one of two 1/2-inch metal straps securing the ladder.

The use of 1/2-inch steel strapping to restrain various items to the LA is not recommended. Recommend all steel strapping be of at least 3/4-inch width or preferably 1-1/4-inch width for rail movement.

The LA remained operational following the rail impact test.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 4

LOAD NO. 4

DATE: 23 April 1987

SPECIMEN LOAD: Launch Assembly of the Remotely Piloted Vehicle System
loaded on a railroad flatcar.

TEST FLATCAR NO. GN 60270 LT. WT. 53,700 Lbs.

REFERENCE LOAD NO. 4 WT. 11,552 Lbs.

TOTAL SPECIMEN WT. 65,252 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	B	4.53	Ladder moved forward 3/8 inch.
2-A	B	6.01	Ladder moved forward an additional 1/2 inch.
3-A	B	8.00	Ladder moved forward an additional 1-1/4 inches. Mudflaps moved forward 1-1/4 inches.
4-B	A	8.06	Metal strap over ladder broke. Ladder moved rearward 6-1/8 inches. Mudflaps moved rearward 2-1/4 inches. Launch Assembly moved rearward 5/8 inch.

DATE: 25 April 1987

RAIL IMPACT TEST DATA

DATE: 25 April 1987

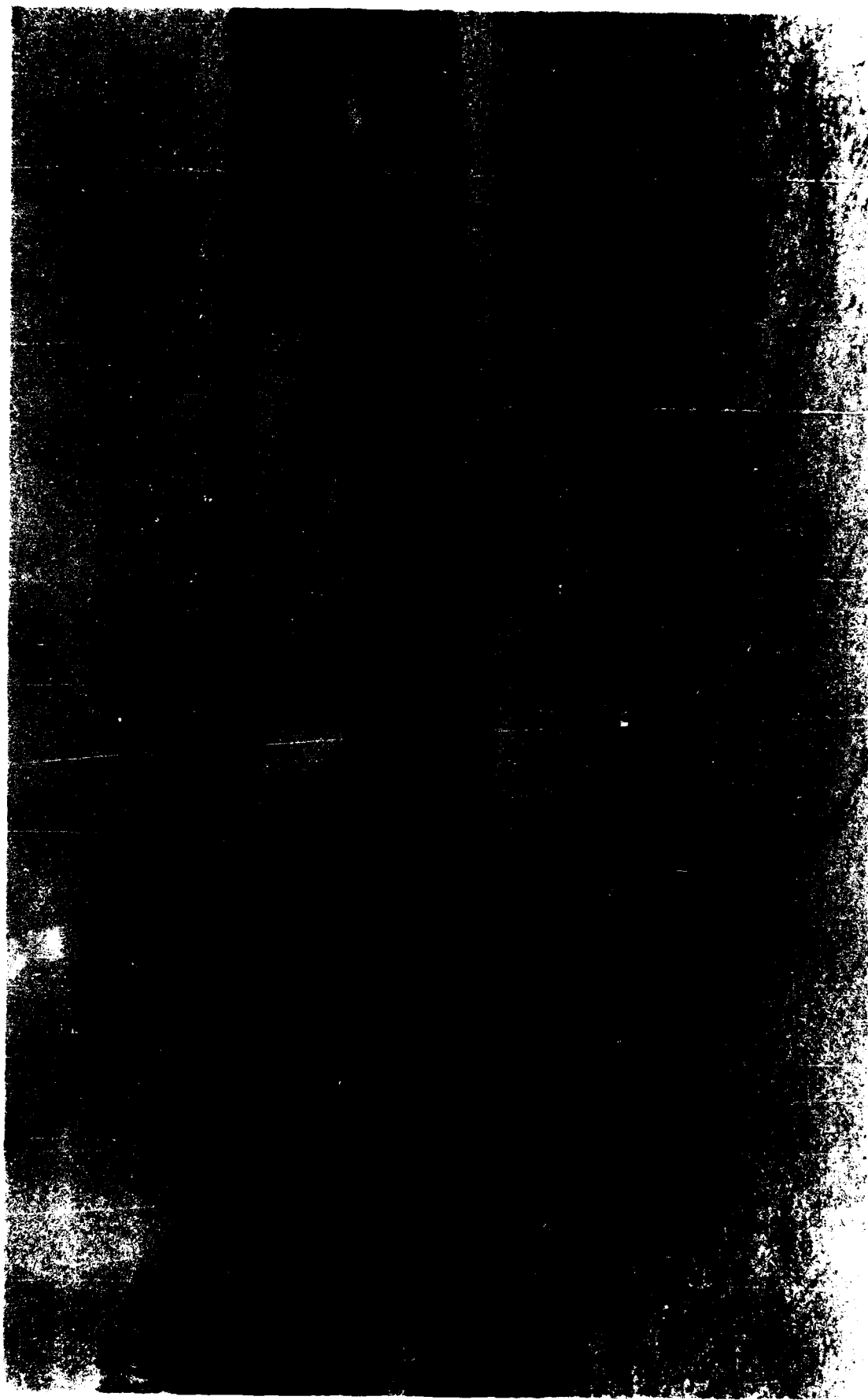
LAUNCH COMMAND MODULE ; RAILCAR

PALLET FLOOR

FORWARD END OF RAIL :

[illegible]

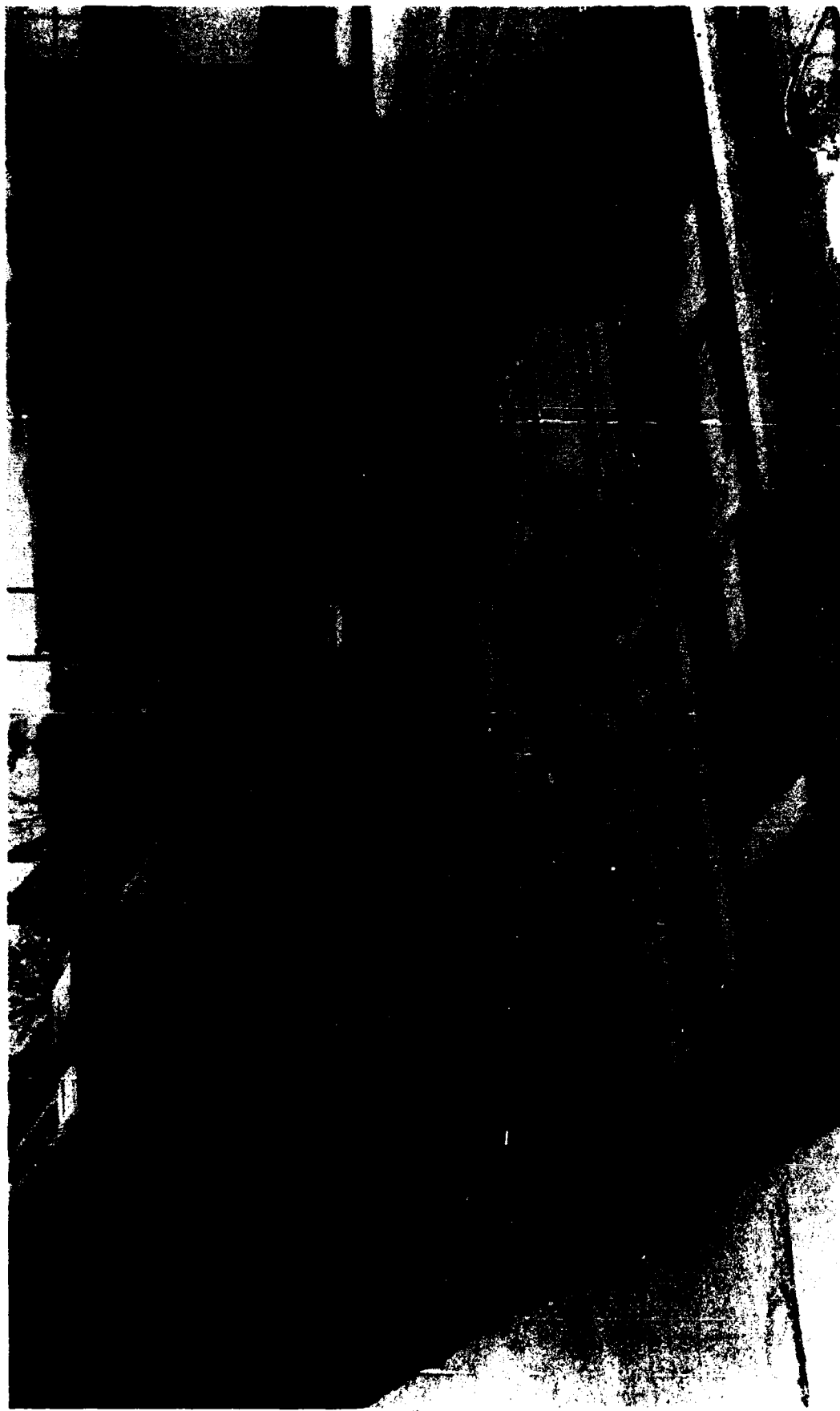
	1	2	3	4														
4.53:144,000	1.40	150.0	0.55	70.0	1.75	150.0	0.20	150.00	0.40	50.00	0.96	100.0	0.05	50.00	0.90	50.0	3.25	100.00
6.01:180,000	1.75	175.0	1.05	100.0	2.00	150.0	0.20	50.00	0.50	50.10	1.10	150.0	0.05	50.00	1.25	100.00	4.00	150.00
8.00:316,000	3.90	200.0	1.14	100.0	4.00	150.0	0.50	50.00	1.05	90.00	2.20	180.0	0.05	50.00	1.50	50.00	8.13	80.00
8.06:320,000	0.60	150.0	1.32	100.0	5.50	100.0	0.30	150.00	2.00	50.00	2.30	150.0	0.05	50.00	2.20	100.00	12.15	60.00



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

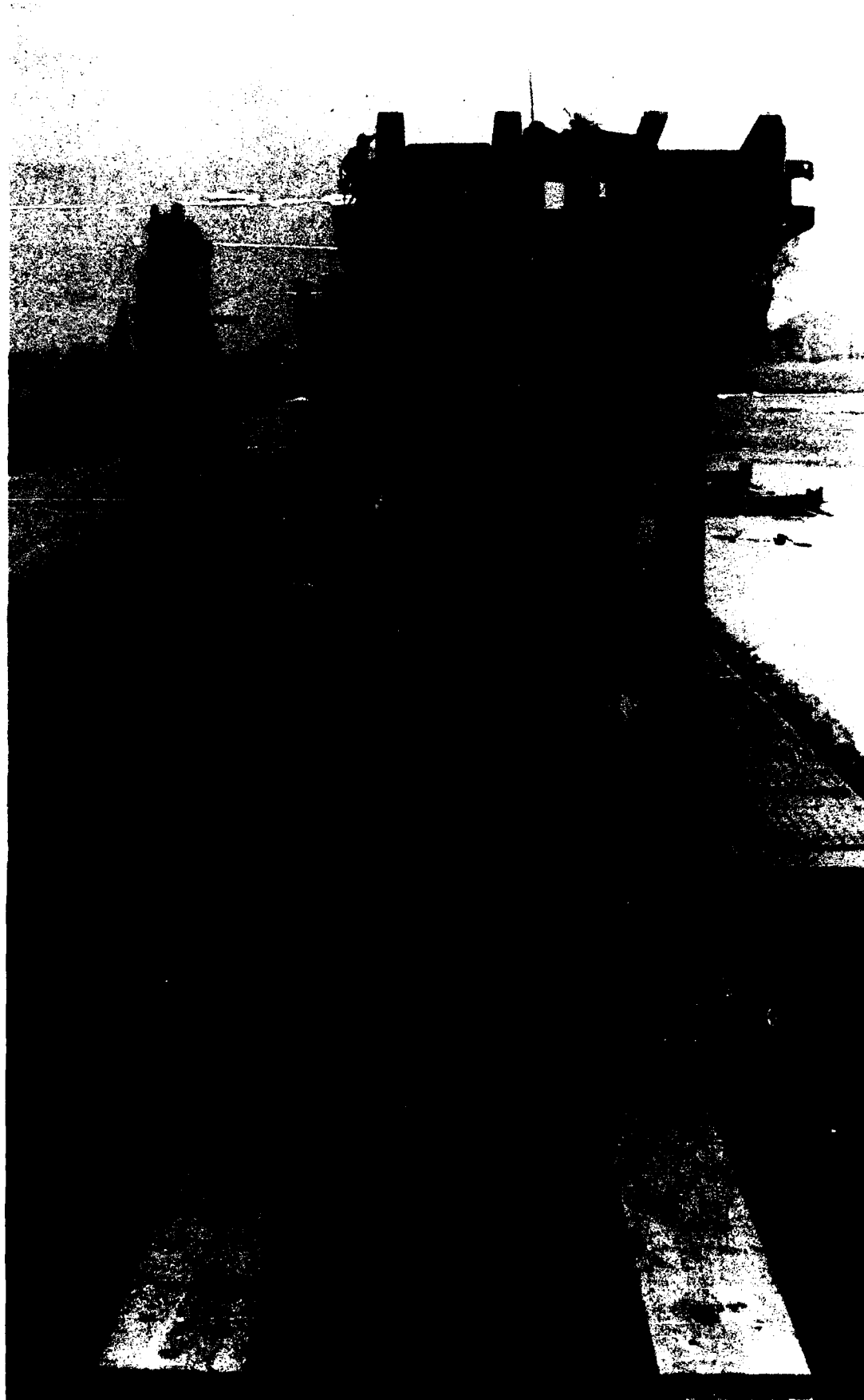
View of Launch Assembly secured to a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

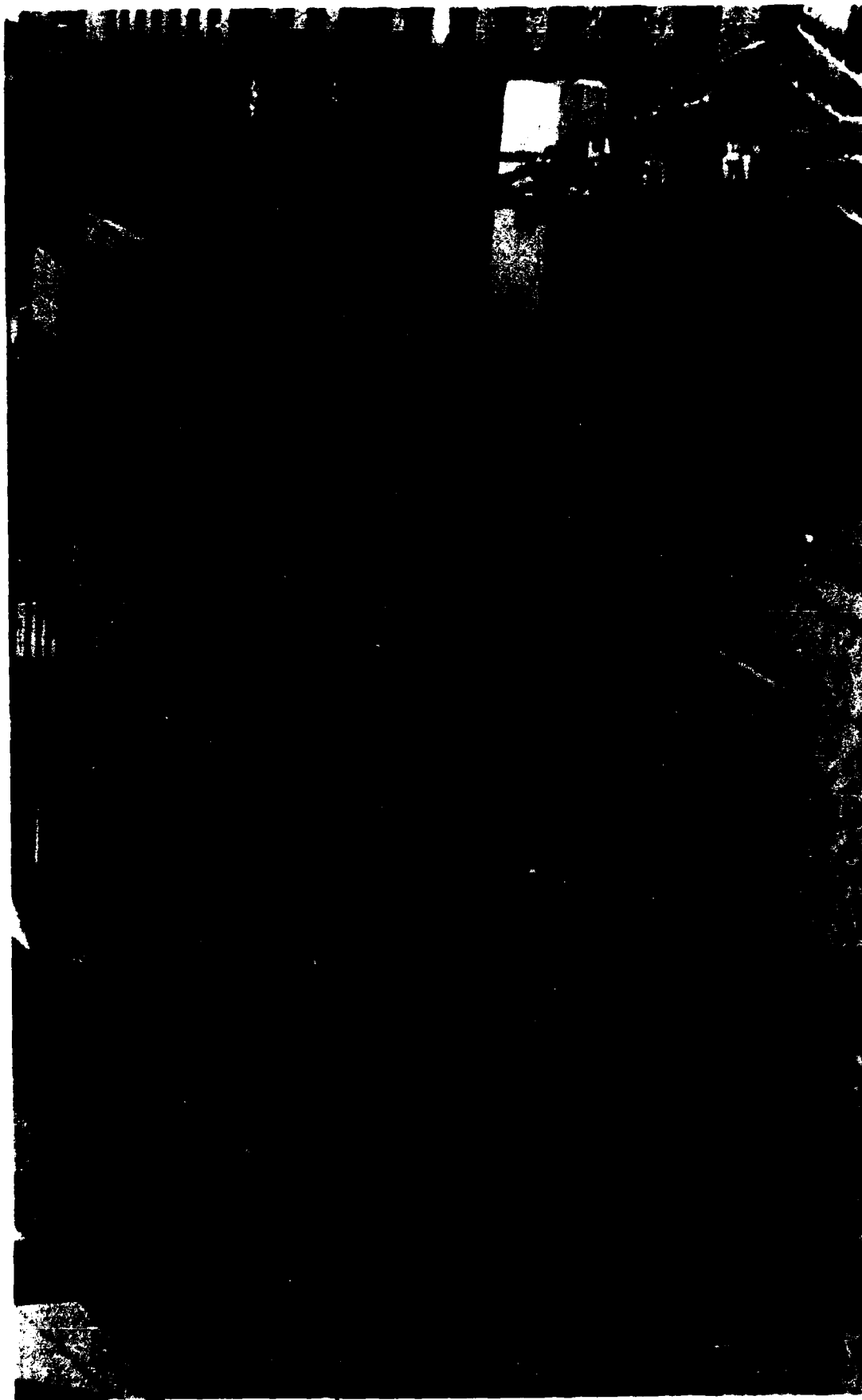
View of trailing end of the Launch Assembly. Note instrumentation cables leading to the accelerometer into the enclosed Launch Command Module, the enclosed pallet floor, and the location of the accelerometer on the railcar floor.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

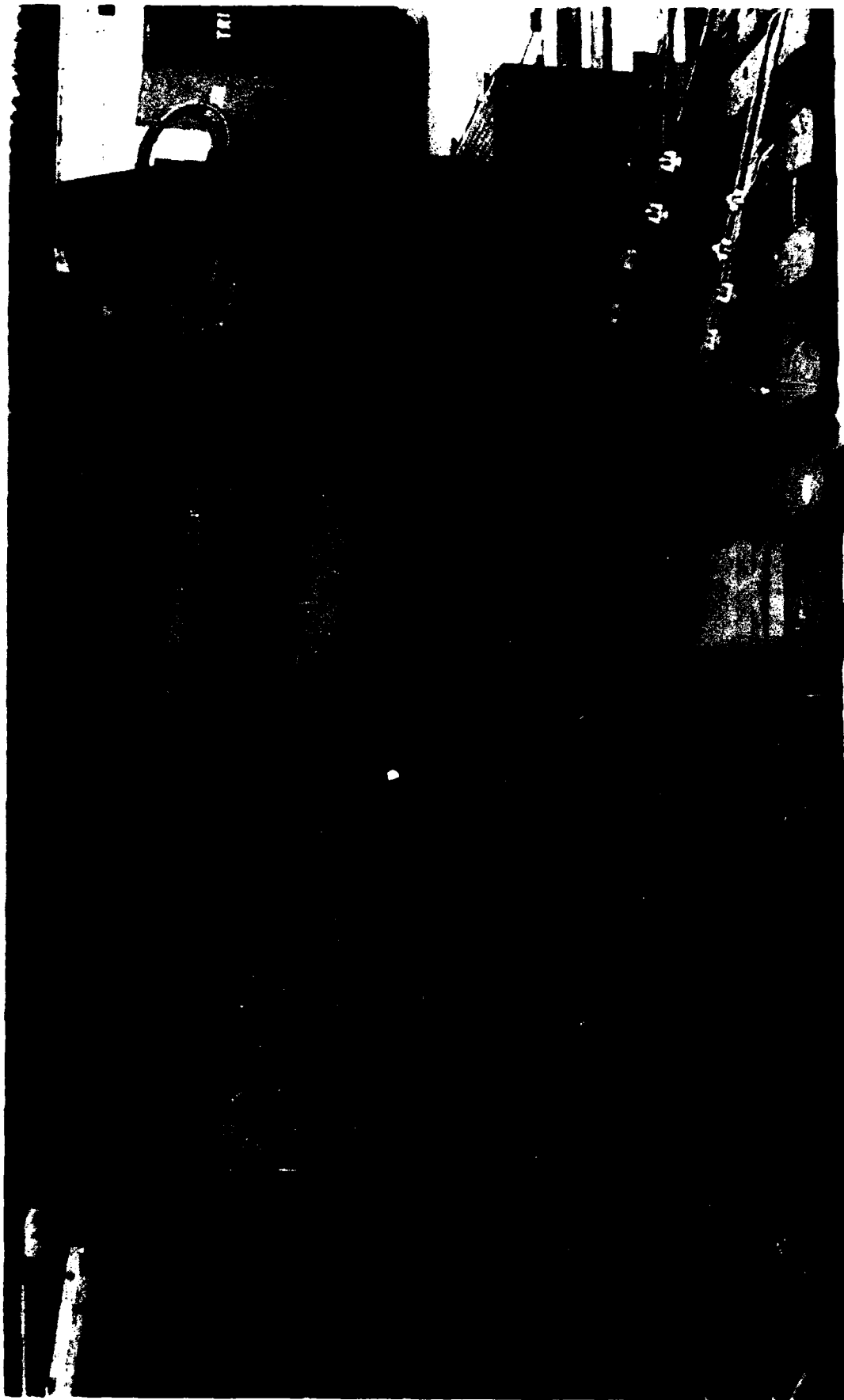
View of forward end of the Launch Assembly. Note accelerometer mounted on forward end of the rail.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

View of the mudflaps secured to the Launch Assembly pallet.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

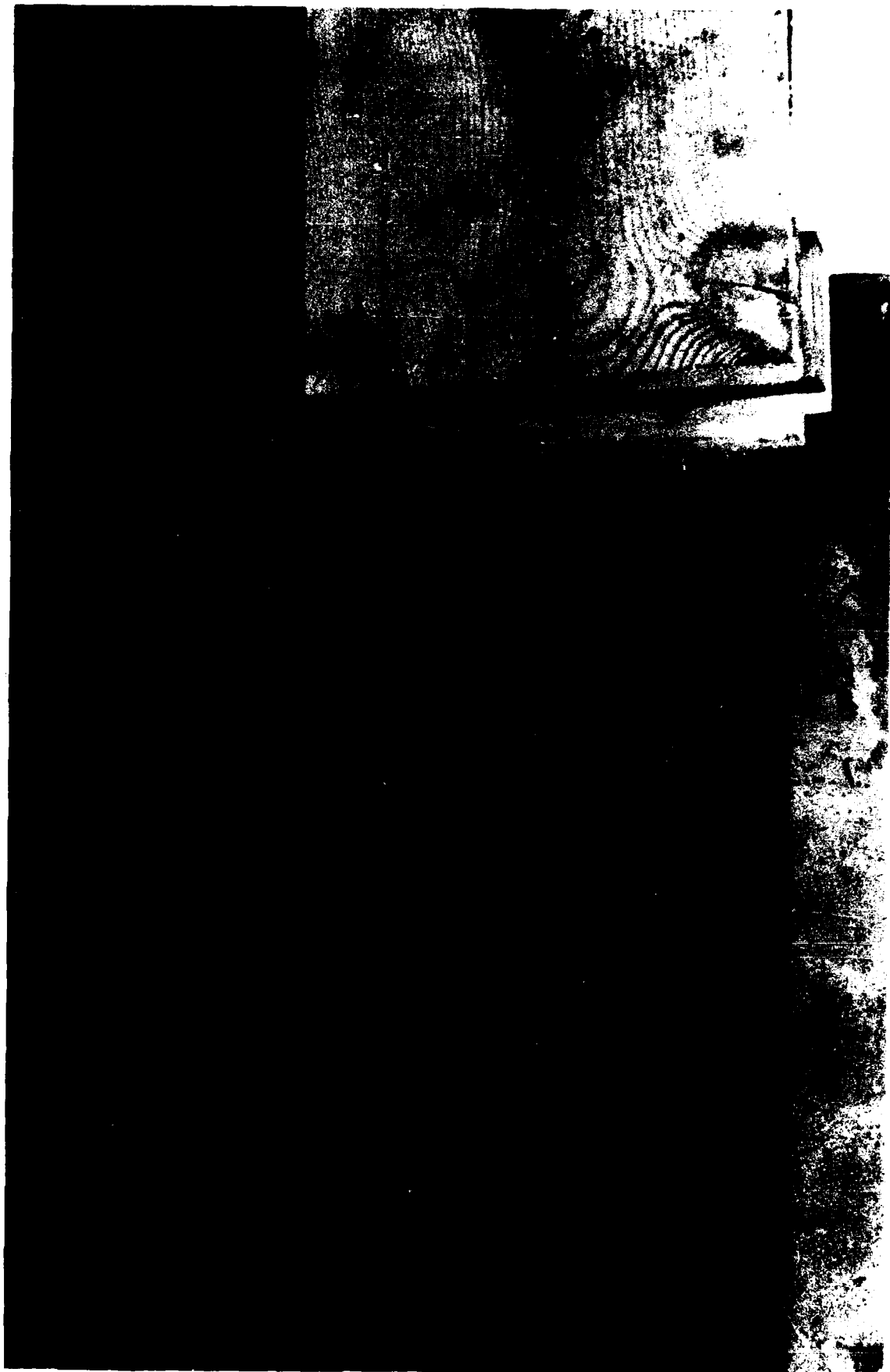
View of the ladder secured to the Launch Assembly pallet.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 6

View of the ladder following 8 mph reverse impact. Note the failed 1/2-inch steel band.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 7

View of the 5/8-inch void between the end of the Launch Assembly pallet and the wooden header following the 6 mph reverse impact.

AIR VEHICLE HANDLER

SYNOPSIS OF TEST

This Air Vehicle Handler (AVH) test is a followup test to the previous engineering transportability rail impact test performed with a simulated AVH and simulated Air Vehicle (AV). In this test, the actual AVH was positioned on the all-wooden floor railroad flatcar and restrained per a previously approved tiedown procedure. Each of the two Air Vehicle Containers were secured to the cargo bed with five web strap tiedown assemblies.

The instrumented AV was placed in the Air Vehicle Container immediately forward of the AVH on-board crane.

Accumulated movement during the rail impact tests never exceeded one inch. The actual Air Vehicle in the container remained undamaged during the test.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 5

LOAD NO. 5

DATE: 25 April 1987

SPECIMEN LOAD: Air Vehicle Handler loaded with two Air Vehicle Containers, one of which contains an actual Air Vehicle.

TEST FLATCAR NO. SP&S 34094 LT. WT. 47,200 Lbs.

REFERENCE LOAD NO. 5 WT. 32,383 Lbs.

TOTAL SPECIMEN WT. 79,583 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	B	4.58	Rear container moved forward 1/2 inch.
2-A	B	5.90	Web strap securing on-board crane is slightly loose.
3-A	B	8.28	Air Vehicle Handler moved forward one inch.
4-B	A	8.13	No movement.

RAIL IMPACT TEST DATA

DATE: 25 April 1987

[illegible]



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

View of the Air Vehicle Handler loaded on a railroad flatcar. Two Air Vehicle Containers are secure to the bed of the Air Vehicle Handler.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of the front of the Air Vehicle Handler.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of the rear of the Air Vehicle Handler.

RECOVERY ASSEMBLY

SYNOPSIS OF TEST

The Recovery Assembly (RA) was removed with a mobile crane from the chassis of the 5-ton cargo truck and centered on the all-wooden floor railroad flatcar. The system contractor's restraint procedure included 2-inch X 10-inch lumber for blocking and 5/8-inch diameter wire rope for tie down. Rub blocks were built and located wherever a wire rope contacted the RA. Several items, including a cable spool and two outrigger pads, were secured to the pallet of the RA.

During rail impact, longitudinal movement of the RA was minimal and lateral movement of 5/8-inch was recorded on the trailing end of the RA following the 8 mph forward impact.

Inspection of the RA following the reverse impact revealed permanent deformation under the arms that set on the metal box-type beams of the main structure of the RA. Wooden pads, 1/2-inch thick, were cut and installed under the arms prior to any rail impact testing. The intent of the wooden pads was to cushion the impact and distribute the force over a larger area on the metal box-type beam. The reverse rail impact crushed the wooden pad and deflected the metal box-type beam under it.

Permanent deformation of the metal box-type beam resulted in failing the tested securement system. Recommend the RA be retested using a securement system that contributes no damage to the RPV System during rail impact. (Reference Test Page IV-9).

Although the RA sustained minor deformation, the operational check uncovered no problems.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 6 LOAD NO. 6 DATE: 29 April 1987

SPECIMEN LOAD: Recovery Assembly of the Remotely Piloted Vehicle System
loaded on a railroad flatcar.

TEST FLATCAR NO. SP&S 34094 LT. WT. 47,200 Lbs.

REFERENCE LOAD NO. 6 WT. 14,401 Lbs.

TOTAL SPECIMEN WT. 61,601 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

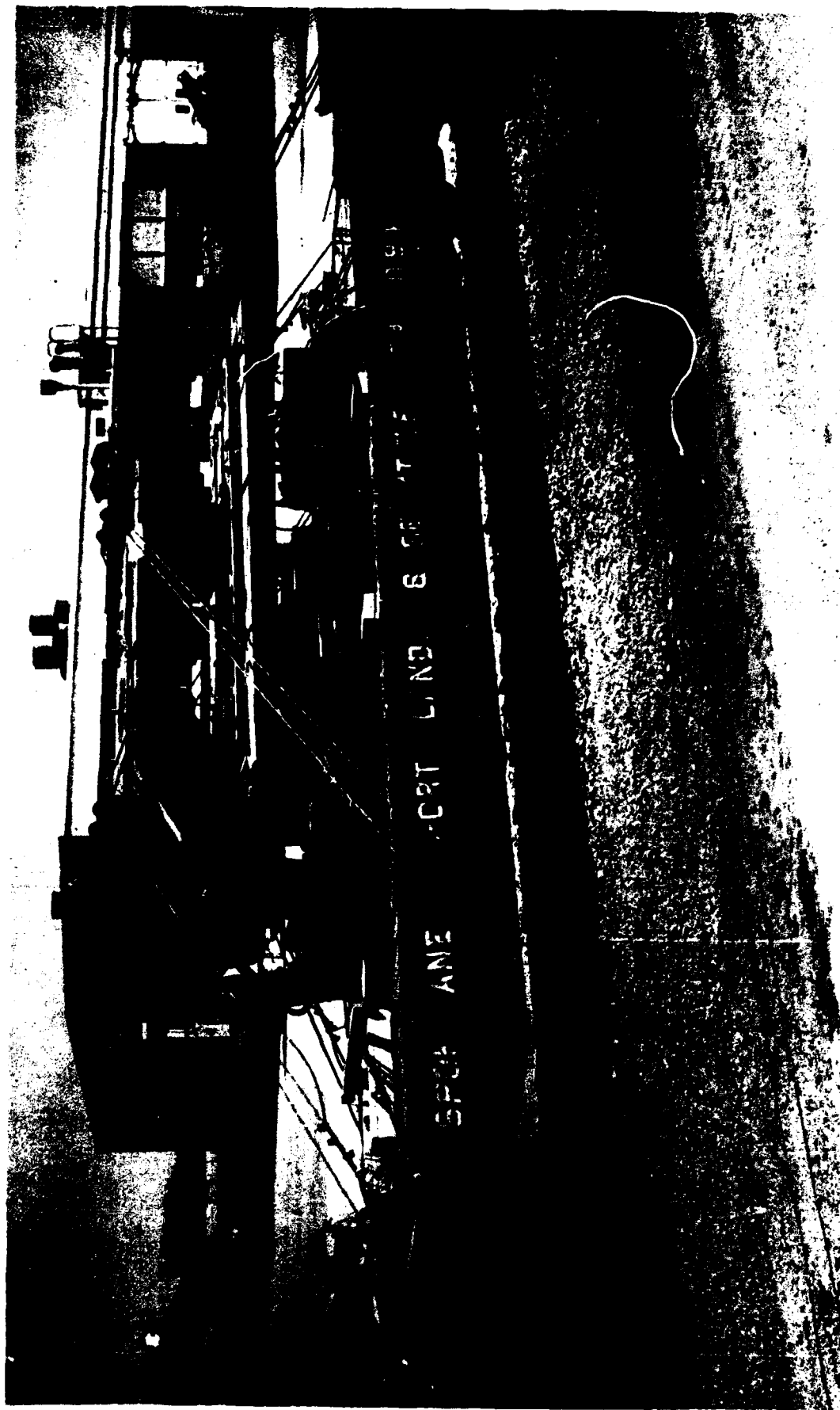
<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	A	4.60	No movement.
2-A	A	6.02	No movement.
3-A	A	8.45	Trailing end of Recovery Assembly moved laterally 5/8 inch.
4-B	B	8.30	Permanent deformation of the box-type beam of the main structure of the RPV.

RECOVERY ASSEMBLY

DATE: 29 April 1987

RAIL IMPACT TEST DATA

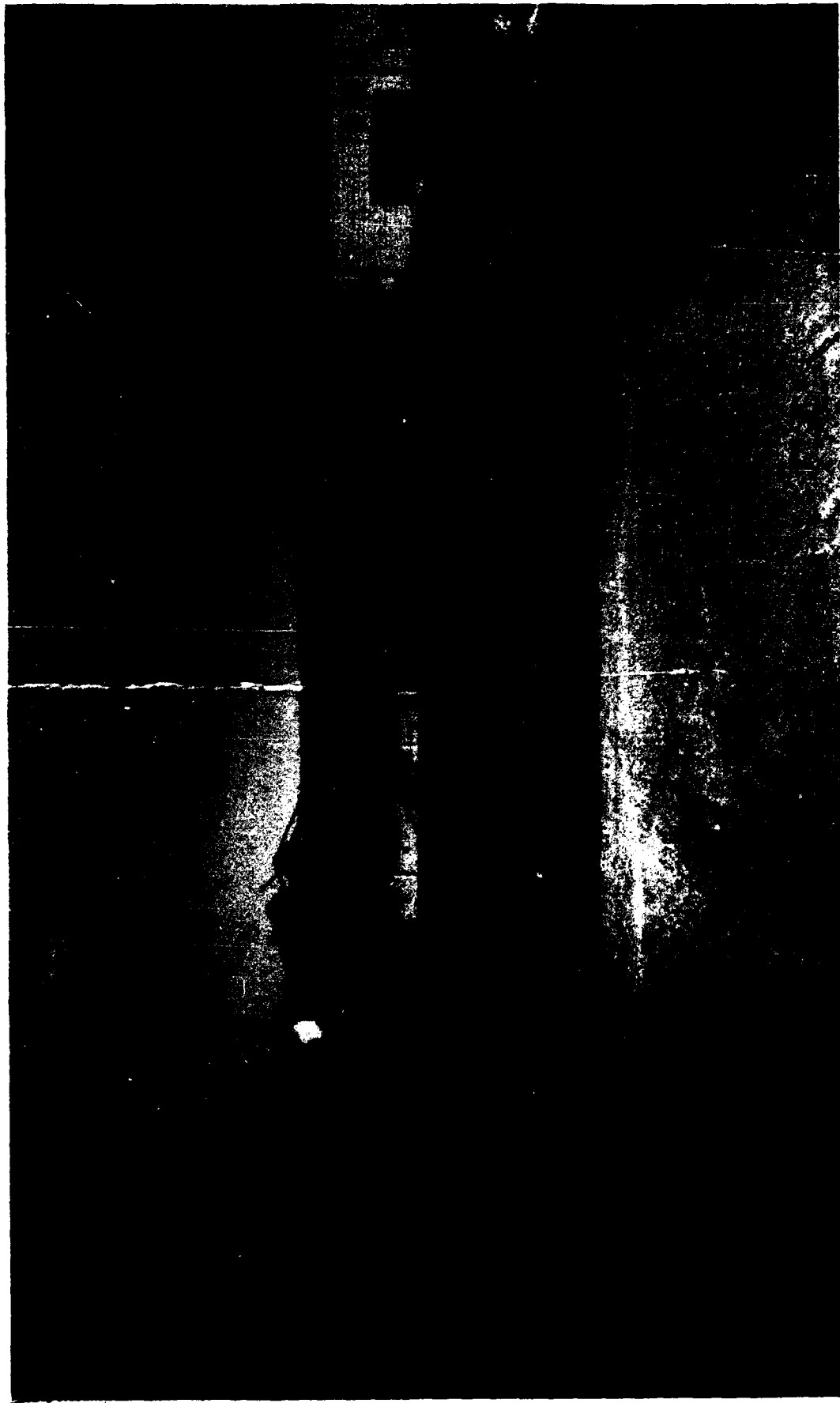
FRONT TRANSPORT										BARNIER SUPPORT BEAM										PALLET FRAME										CAMERA TRANSPORT PLATFORM										TOP OF RAILCAR																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
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DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

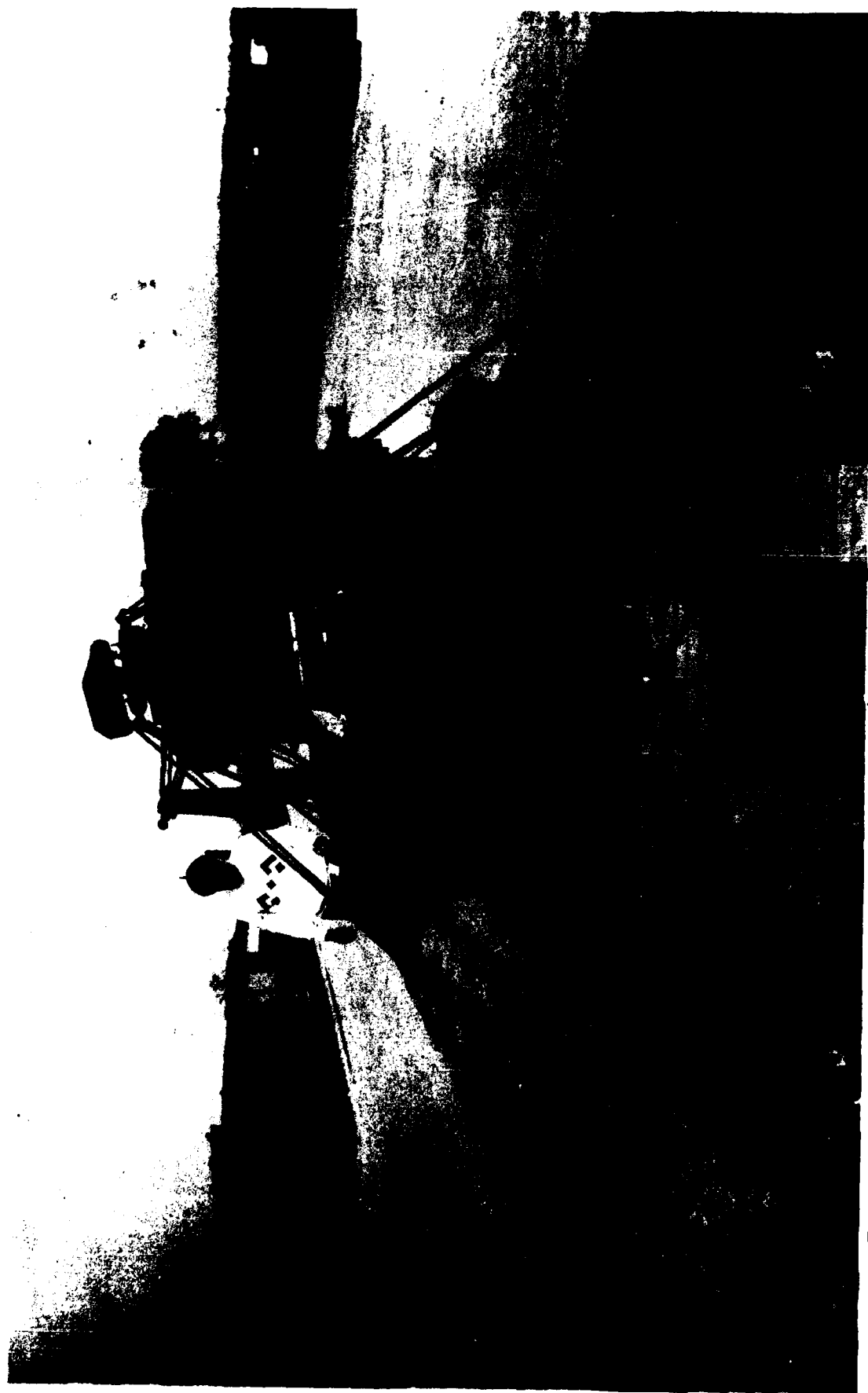
View of the Recovery Assembly restrained on the railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

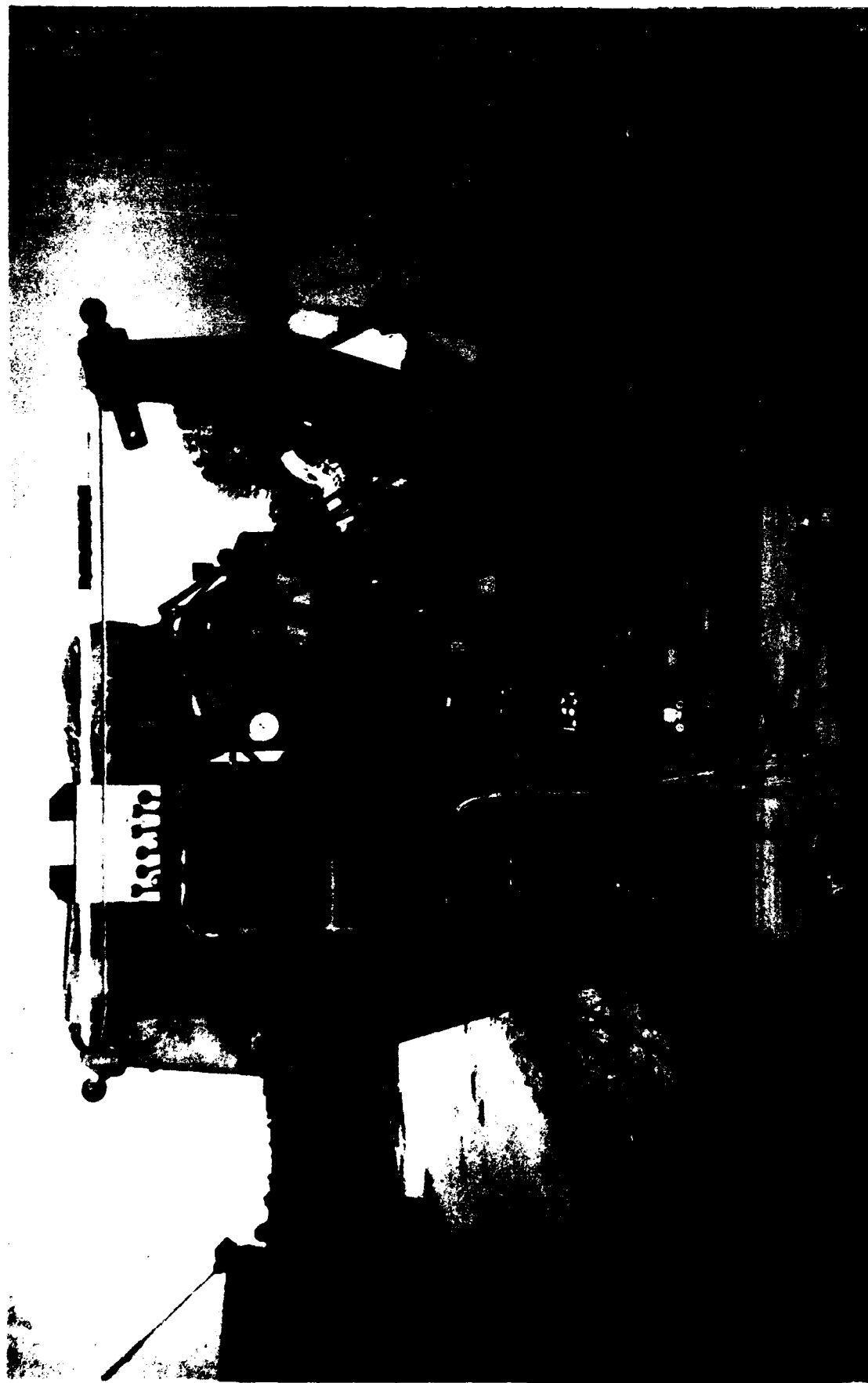
View of the Recovery Assembly restrained on the railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of the forward end of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

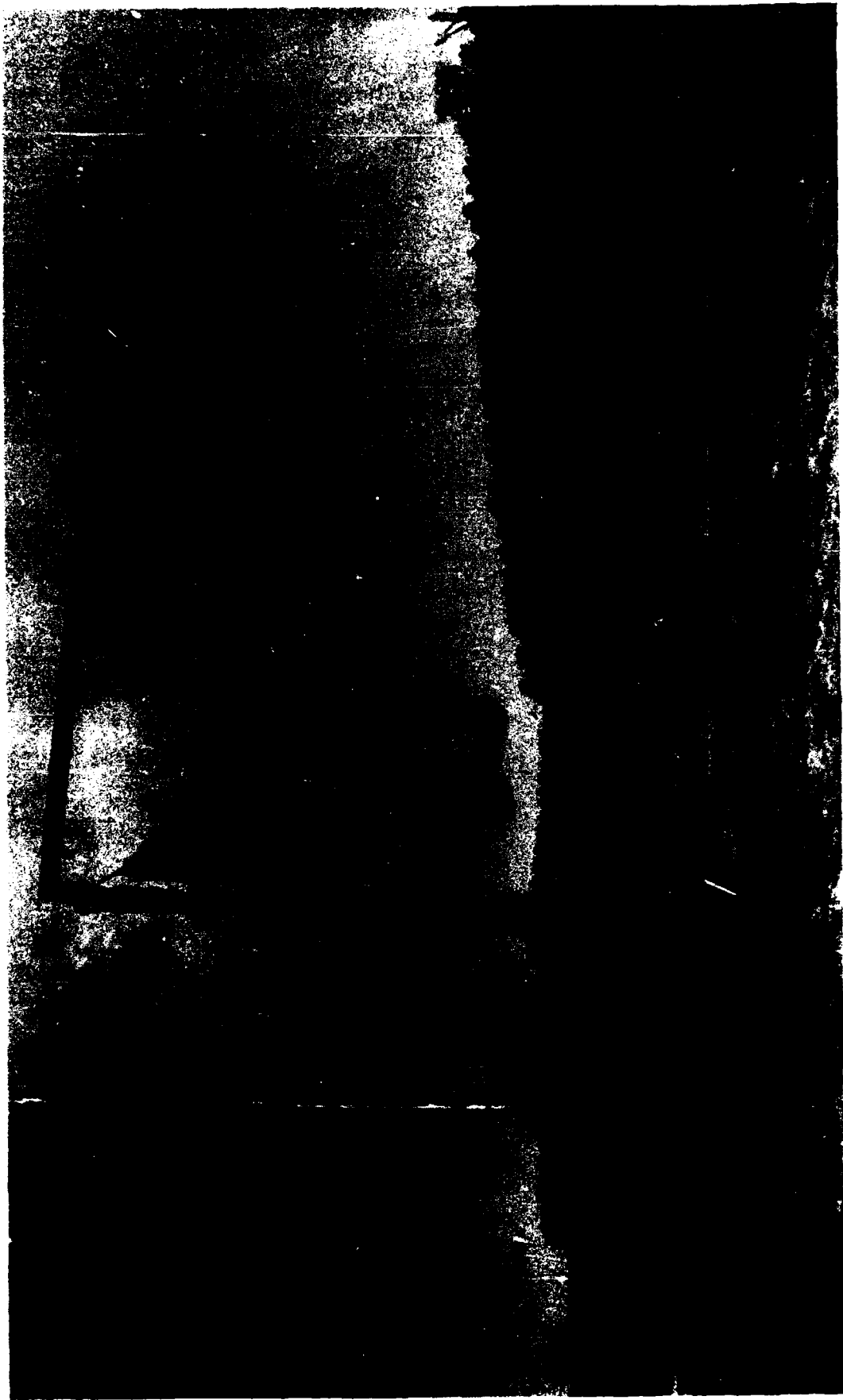
View of the rearward end of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

View of the two arms, two failed wooden pads, and the permanent deflection of the box-type beams of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 6

View of the Recovery Assembly fully extended.

REMOTE GROUND TERMINAL

SYNOPSIS OF TEST

The Remote Ground Terminal (RGT) mounted on a 3/4-ton cargo trailer was blocked, braced, and tied down on the wood/metal floor of a railroad flatcar. The system contractor's restraint procedures used 3/8-inch wire rope, wood chock blocks, and a lunette support block.

The rail impact test produced no movement of the RGT. The operational check of the RGT was completed without incident.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 7

LOAD NO. 7

DATE: 30 April 1987

SPECIMEN LOAD: Remote Ground Terminal of the Remotely Piloted Vehicle
System loaded on a railroad flatcar.

TEST FLATCAR NO. GN 60270 LT. WT. 53,700 Lbs.

REFERENCE LOAD NO. 7 WT. 2,840 Lbs.

TOTAL SPECIMEN WT. 56,540 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	A	4.75	No Movement
2-A	A	6.14	No Movement
3-A	A	8.05	No Movement
4-B	B	7.98 (Less than reqd 8)	No Movement
5-B	B	8.35	No Movement

REMOTE GROUND TERMINAL

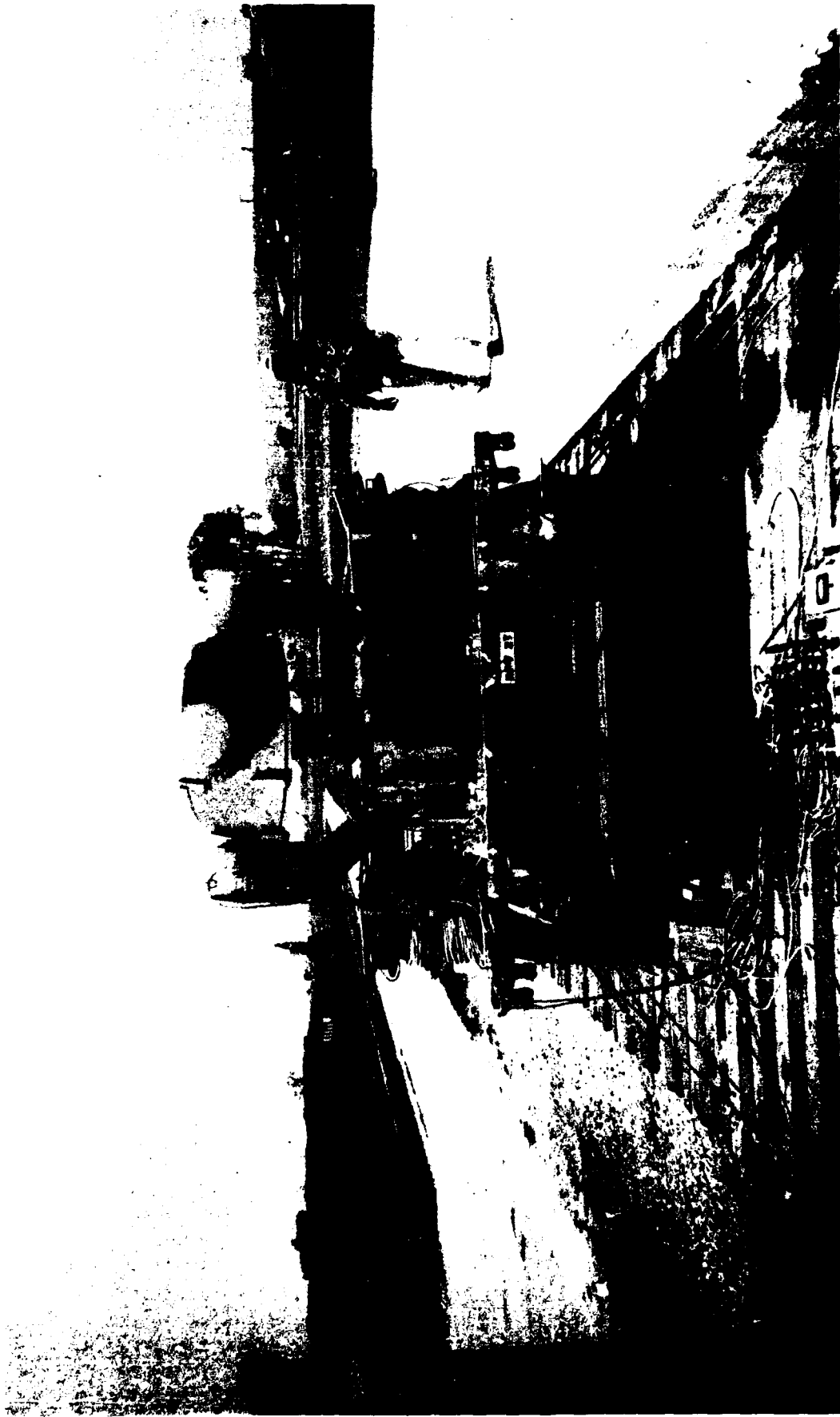
RAIL IMPACT TEST DATA															DATE: 30 April 1987				



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

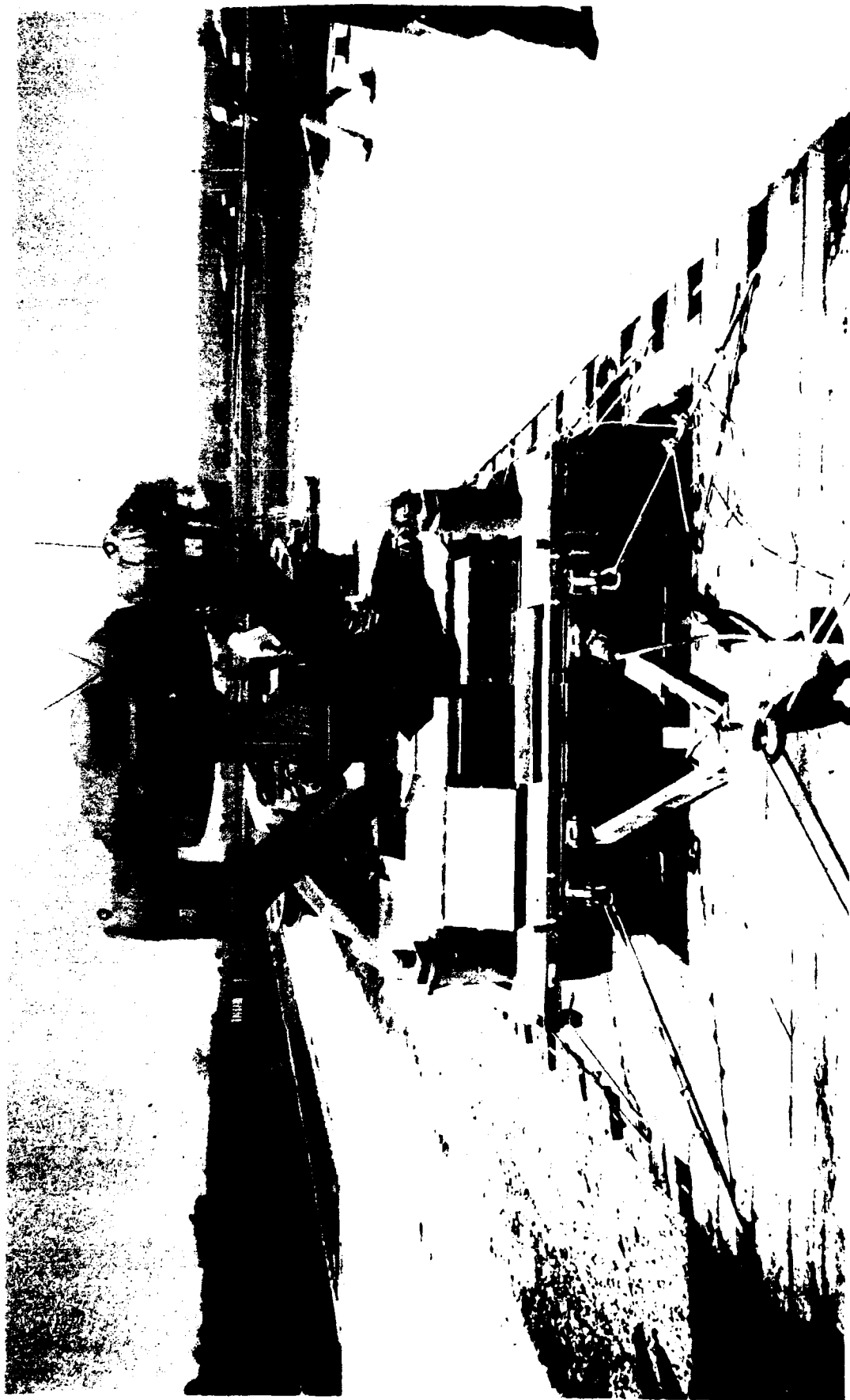
View of the Remote Ground Terminal secured to a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

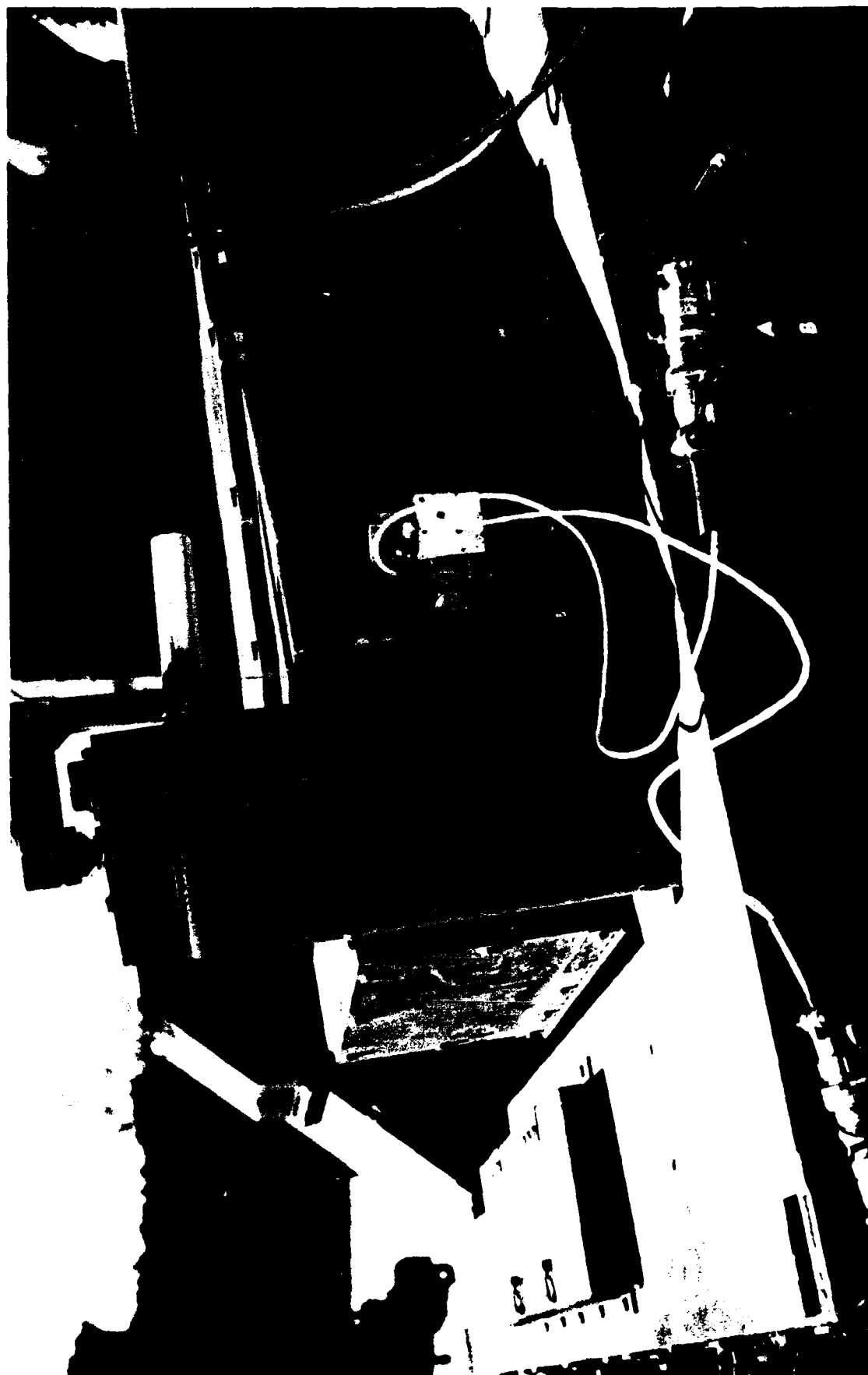
View of trailing end of the Remote Ground Terminal secured to a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

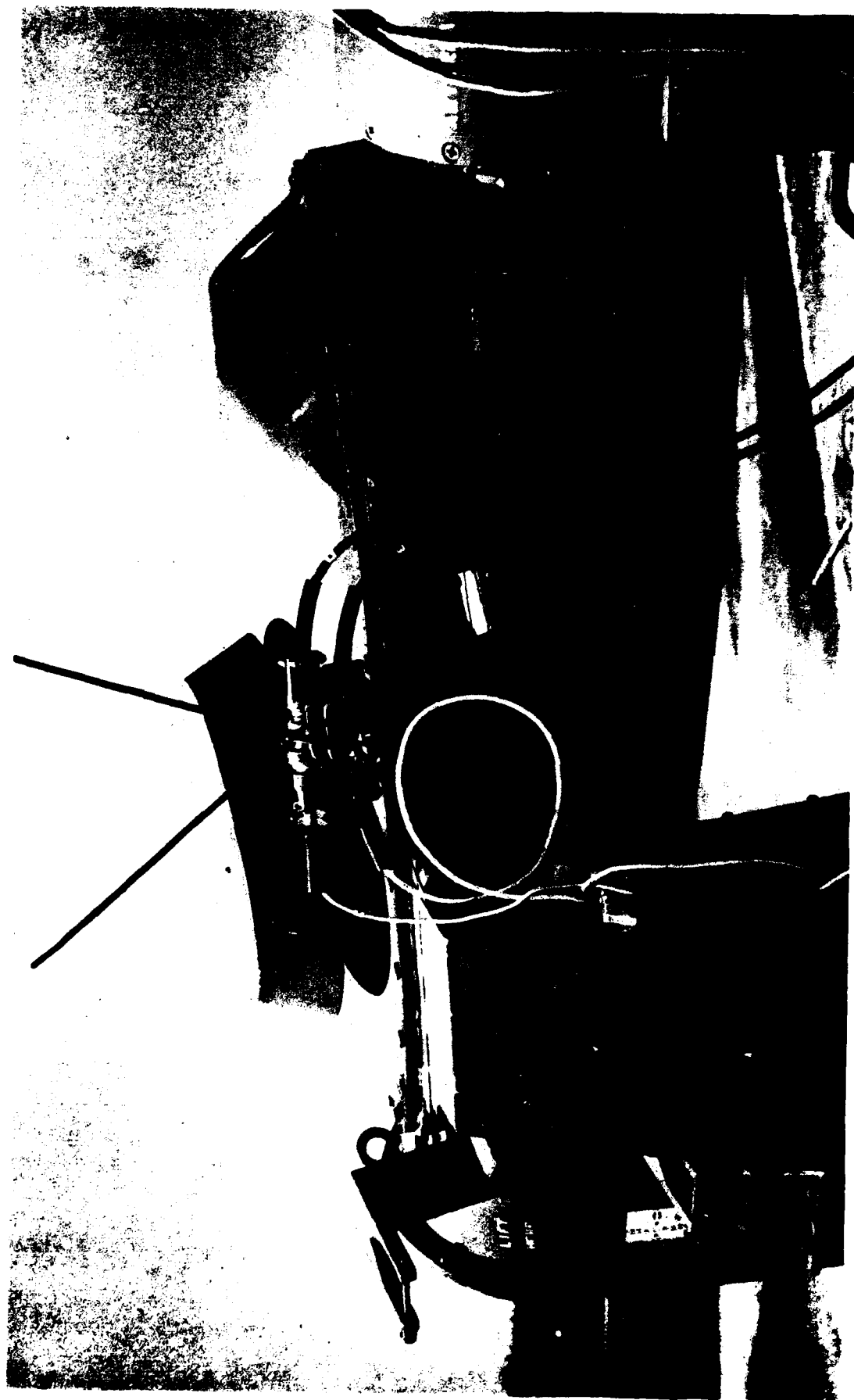
View of forward end of the Remote Ground Terminal secured to a railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

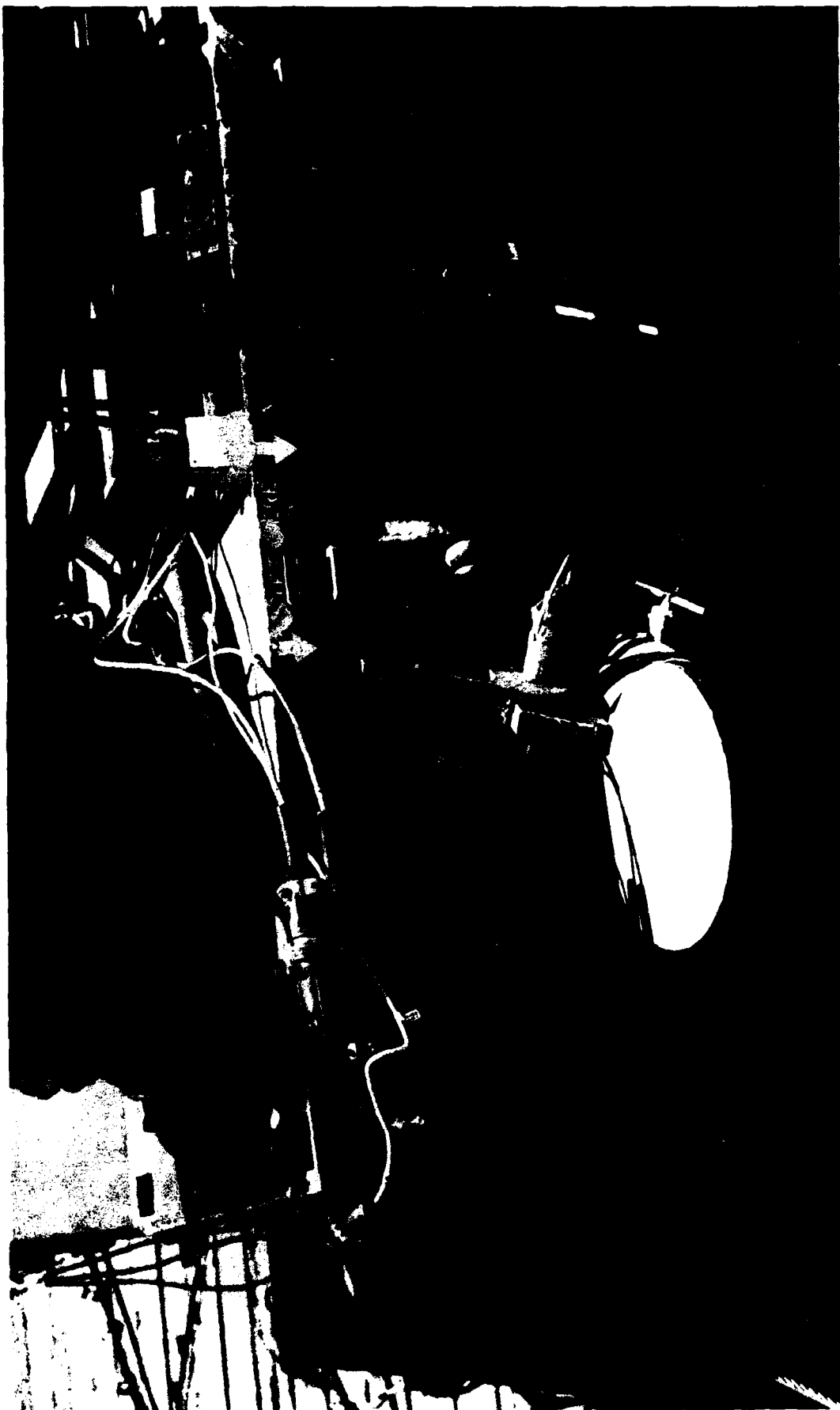
View of accelerometer mounted on Remote Ground Terminal delta base.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

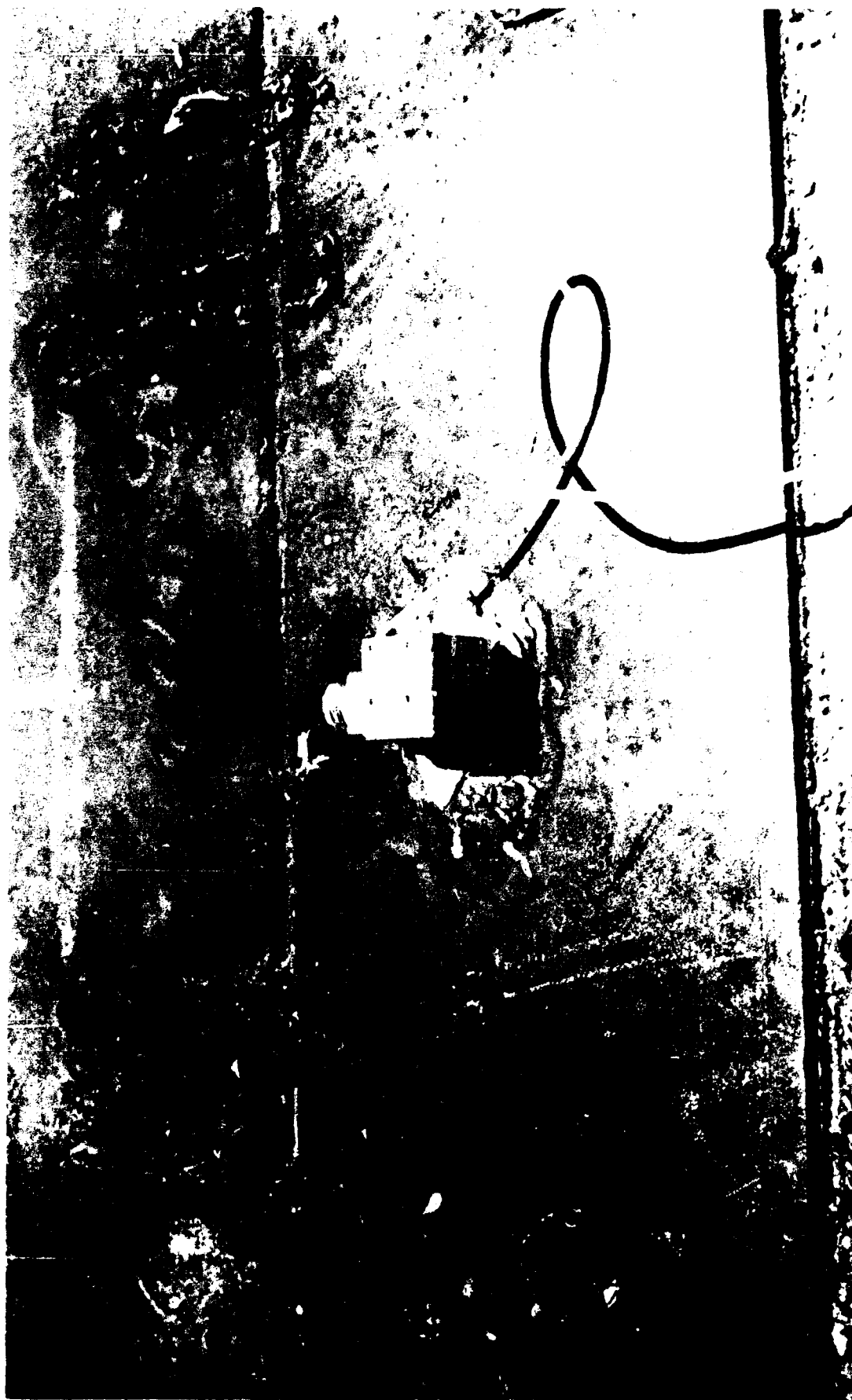
View of accelerometer mounted on Remote Ground Terminal antenna feed assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 6

View of accelerometer mounted on trailer deck.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 7

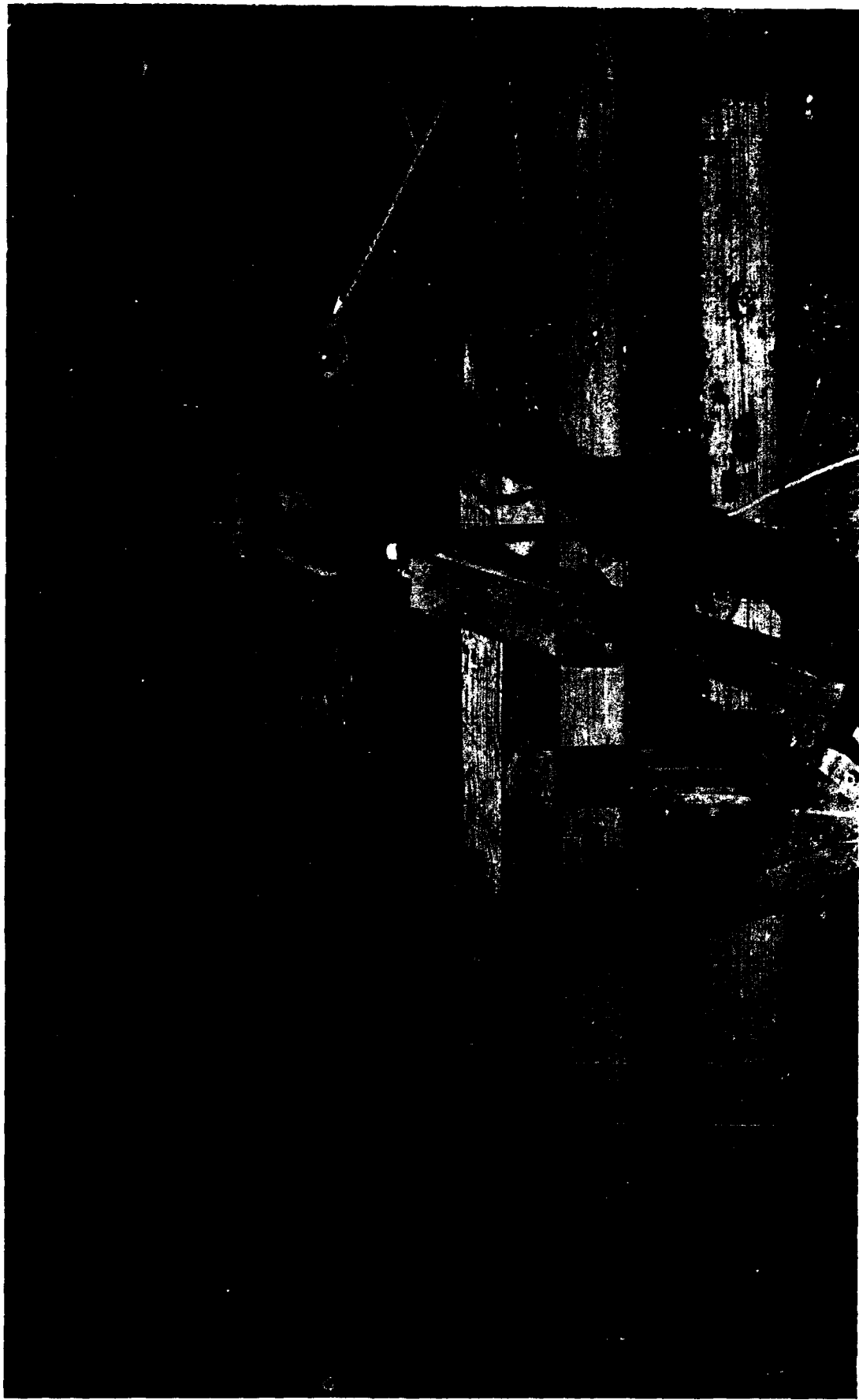
View of accelerometer mounted on floor on top of railcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 8

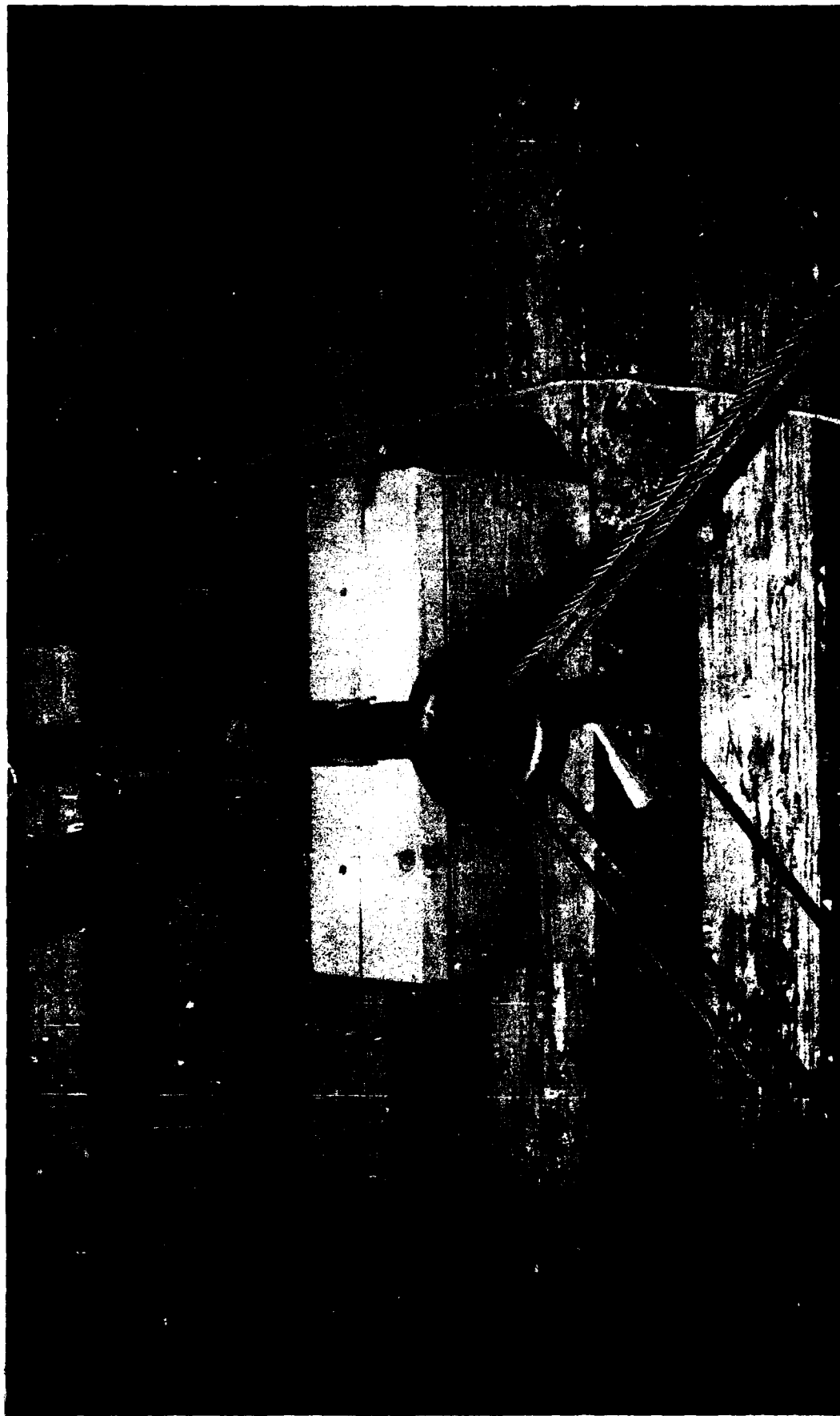
View of wire rope tiedowns looping thru the holes in Remote Ground Terminal trailer wheels.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 9

View of wire rope tiedowns on forward end of the Remote Ground Terminal trailer.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 10

View of wire rope thru the Kemote Ground Terminal trailer lunette.

AIR VEHICLE CONTAINER

SYNOPSIS OF TEST

The system contractor requested the Air Vehicle Container (AVC) with the actual Air Vehicle be removed from the Air Vehicle Handler, instrumented and secured on a railroad flatcar. Using 2-inch banding and wooden floor-line blocking, the AVC was rail impact tested in the longitudinal and lateral directions.

In the first rail impact test, the AVC was positioned with the longitudinal axis of the Air Vehicle parallel with the longitudinal axis of the railroad flatcar. The container remained stationary during the four rail impacts. The AVC was then rotated 90 degrees, which positioned the longitudinal axis of the Air Vehicle perpendicular to the longitudinal axis of the railroad flatcar. Neither the container, nor the Air Vehicle, received any damage during either rail impact test.

The two rail impact tests performed with the AVC secured to the railroad flatcar were for the sole purpose of obtaining, thru instrumentation, the expected loads induced directly from the railroad flatcar. Movement of the AVC in this configuration is not anticipated and no approval is necessary.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 8

LOAD NO. 8

DATE: 1 May 1987

SPECIMEN LOAD: Air Vehicle Container with Air Vehicle loaded on railroad flatcar. Air Vehicle tested positioned (a) longitudinally and (b) laterally on the flatcar.

TEST FLATCAR NO. GN 60270 LT. WT. 53,700 Lbs.

REFERENCE LOAD NO. 8 WT. 1,144 Lbs.

TOTAL SPECIMEN WT. 54,844 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
(a) Longitudinally			
1-A	B	4.82	No movement
2-A	B	6.13	No movement
3-A	B	8.28	No movement
4-B	A	8.35	No movement
(b) Laterally			
1-A	A	4.62	No movement
2-A	A	6.22	No movement
3-A	A	8.20	No movement
4-B	4-B	8.28	No movement

LATERAL ENGINEERING TEST OF AIR VEHICLE CONTAINER

DATE: 1 May 1987

RAIL IMPACT TEST DATA

BULKHEAD										CRADLE										CONTAINER FLOOR										RAILCAR									
COUPLER		LAT		LONG		VERT		LAT		LONG		VERT		LAT		LONG		VERT		LAT		LONG		VERT		LAT		LONG		VERT		LAT		LONG		VERT			
IMPACT:	SPEED:	FORCE:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:	FORCE:	DUR:			
NO.	(MPH)	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS	GS	MS				
1	4.62	120,000	--	--	2.50	100	0.63	120.0	--	--	3.50	100.0	0.65	100.0	--	--	2.00	50.00	1.45	20.00	2.00	75.00	--	--	2.00	50.00	1.45	20.00	2.00	75.00	--	--	2.00	50.00	1.45	20.00			
2	6.22	200,000	--	--	3.75	120.0	1.00	150.0	--	--	4.50	120.0	0.56	75.0	--	--	2.50	50.00	2.38	20.00	2.50	100.00	--	--	2.50	50.00	2.38	20.00	2.50	100.00	--	--	2.50	50.00	2.38	20.00			
3	8.20	260,000	0.38	100.0	4.70	120.0	1.38	150.0	0.50	50.00	5.75	120.0	1.10	50.0	--	--	6.38	50.00	2.40	20.00	4.75	50.00	--	--	6.38	50.00	2.40	20.00	4.75	50.00	--	--	6.38	50.00	2.40	20.00			
4	8.28	240,000	0.38	100.0	5.00	150.0	1.38	150.0	0.32	50.00	5.40	120.0	1.30	100.0	--	--	8.25	50.00	1.63	20.00	3.50	50.00	--	--	8.25	50.00	1.63	20.00	3.50	50.00	--	--	8.25	50.00	1.63	20.00			



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

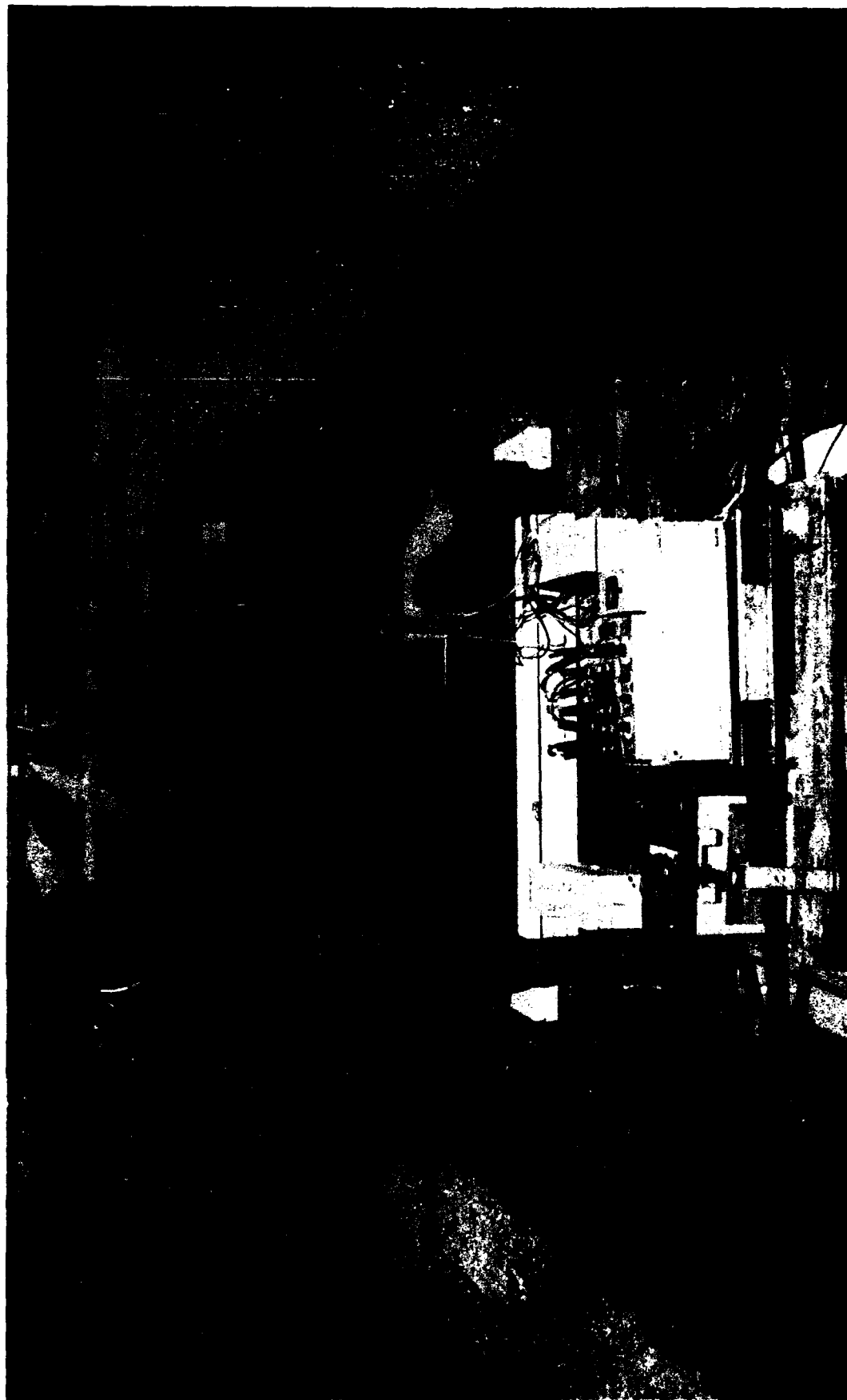
View of Air Vehicle Container secured longitudinally on the railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of Air Vehicle Container secured to railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

View of Air Vehicle Container and instrumentation package on railroad flatcar.

RECOVERY ASSEMBLY

SYNOPSIS OF TEST

The results of the previous rail impact test of the Recovery Assembly (RA) necessitated a retest. The blocking, bracing, cabling, and bearing plates under the arms of the RA were revised.

The previously tested RA was removed from the chassis of the 5-ton cargo truck with a mobile crane and centered on the all-wooden floor railroad flatcar. The amount of blocking and bracing material used in the retest was reduced in both quantity and size of pieces (2-inch X 10-inch vs 2-inch X 6-inch). The quantity of 5/8-inch wire rope tie-down was reduced by 50 percent in the retest.

The deformed area of the structural box-type beam under the arms of the RA was covered with a 1/4-inch thick steel plate. The steel plate transferred the force applied near the center of the box-type beam to the edge of the box-type beam, which has greater strength. The plate also distributed the force over a larger area on the box-type beam.

The four rail impacts were completed without further damage to the box-type beam. A design change, installing a permanent stiffener plate on the box-type beam for the arm to contact, is a requirement to prevent permanent deformation of the beam.

TEST SPECIMENS AND RESULTS

RAIL IMPACT TEST DATA

TEST NO. 9 LOAD NO. 9 DATE: 2 May 1987

SPECIMEN LOAD: Recovery Assembly of the Remotely Piloted Vehicle System loaded on a railroad flatcar.

TEST FLATCAR NO. SP&S 34094 LT. WT. 47,200 Lbs.

REFERENCE LOAD NO. 9 WT. 14,401 Lbs.

TOTAL SPECIMEN WT. 61,601 Lbs.

BUFFER CAR (5 CARS) WT. 251,000 Lbs.

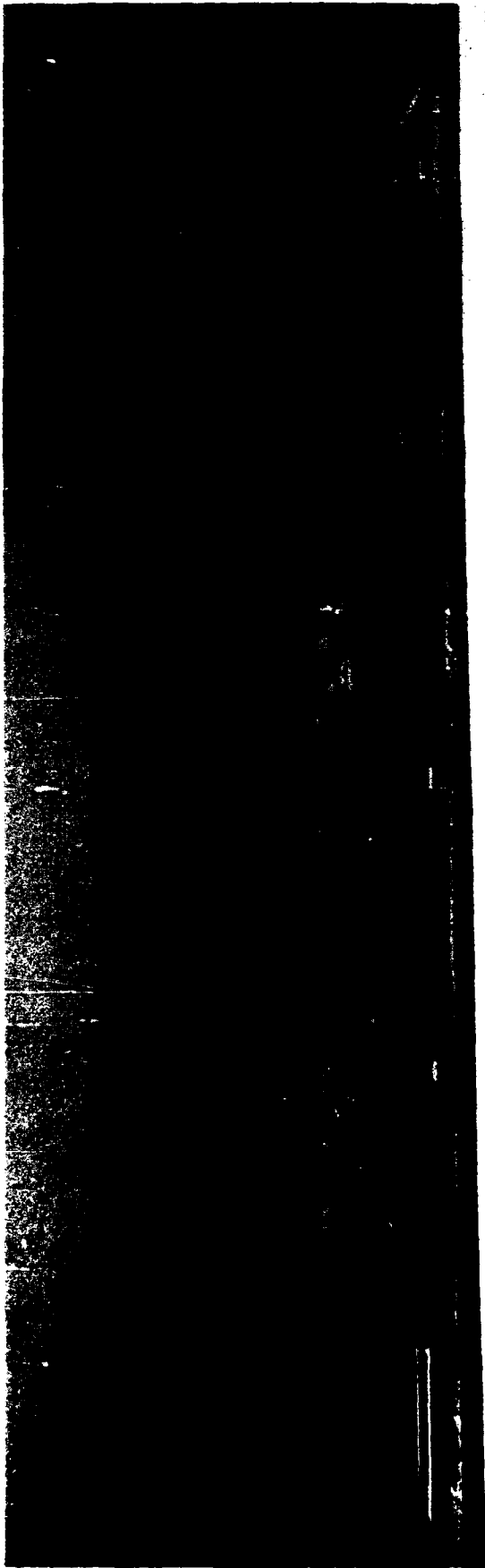
<u>IMPACT</u>	<u>END STRUCK</u>	<u>VELOCITY (mph)</u>	<u>REMARKS</u>
1-A	A	4.92	No movement.
2-A	A	6.26	Assembly moved forward 1/16 inch.
3-A	A	8.20	Assembly moved an additional 1/16 inch forward.
4-B	B	8.21	Assembly moved rearward 3/4 inch.

RECOVERY UNIT

RAIL IMPACT TEST DATA

DATE: 4 May 1987

: BARRIER SUPPORT BEAM :										: FRONT TRANSPORT :										: PALLET BASE :										: CAMERA PLATFORM :										: RAILCAR :									
: COUPLER :					: LONG :					: VERT :					: LONG :					: VERT :					: LONG :					: VERT :					: LONG :					: VERT :									
: IMPACT SPEED: FORCE :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :					: DUR: FORCE: :									
: NO. : (MPH) : (LBS) :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :					: GS : MS : GS :									
: 1 :					4.92 : 180,000 :					50.00 : 0.20 : 50.00 :					3.40 : 100.0 : 1.00 :					100.0 : 2.60 : 120.0 :					0.20 : 20.00 : 3.25 :					80.00 : 0.20 : 50.00 :					1.50 : 50.00 : 1.90 :					100.0 :									
: 2 :					6.26 : 200,000 :					50.00 : 0.20 : 50.00 :					3.90 : 100.0 : 1.50 :					50.0 : 3.10 : 130.0 :					0.56 : 80.00 : 3.30 :					0.20 : 50.00 : 2.00 :					50.00 : 50.00 : 2.20 :					120.0 :									
: 3 :					8.20 : 290,000 :					50.00 : 0.48 : 50.00 :					4.75 : 120.0 : 2.30 :					100.0 : 4.25 : 180.0 :					0.70 : 50.00 : 4.60 :					0.20 : 50.00 : 3.75 :					50.00 : 50.00 : 3.25 :					100.0 :									
: 4 :					8.21 : 276,000 :					50.00 : 0.82 : 50.00 :					4.25 : 130.0 : 1.15 :					50.0 : 4.25 : 140.0 :					0.50 : 50.00 : 3.50 :					0.20 : 50.00 : 3.50 :					50.00 : 50.00 : 3.25 :					100.0 :									



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. i

View of Recovery Assembly restrained on the railroad flatcar.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of forward end of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 3

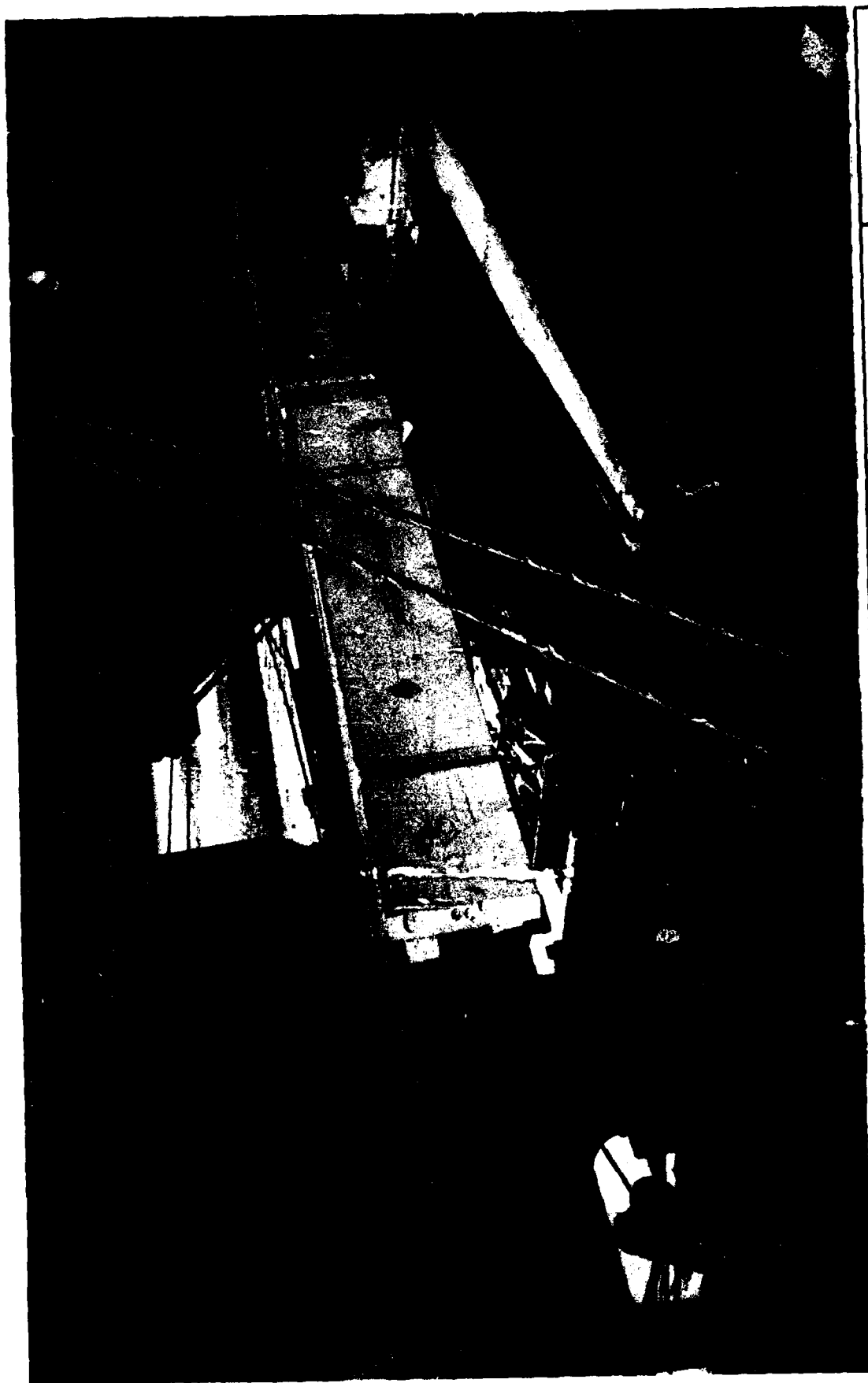
View of trailing end of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 4

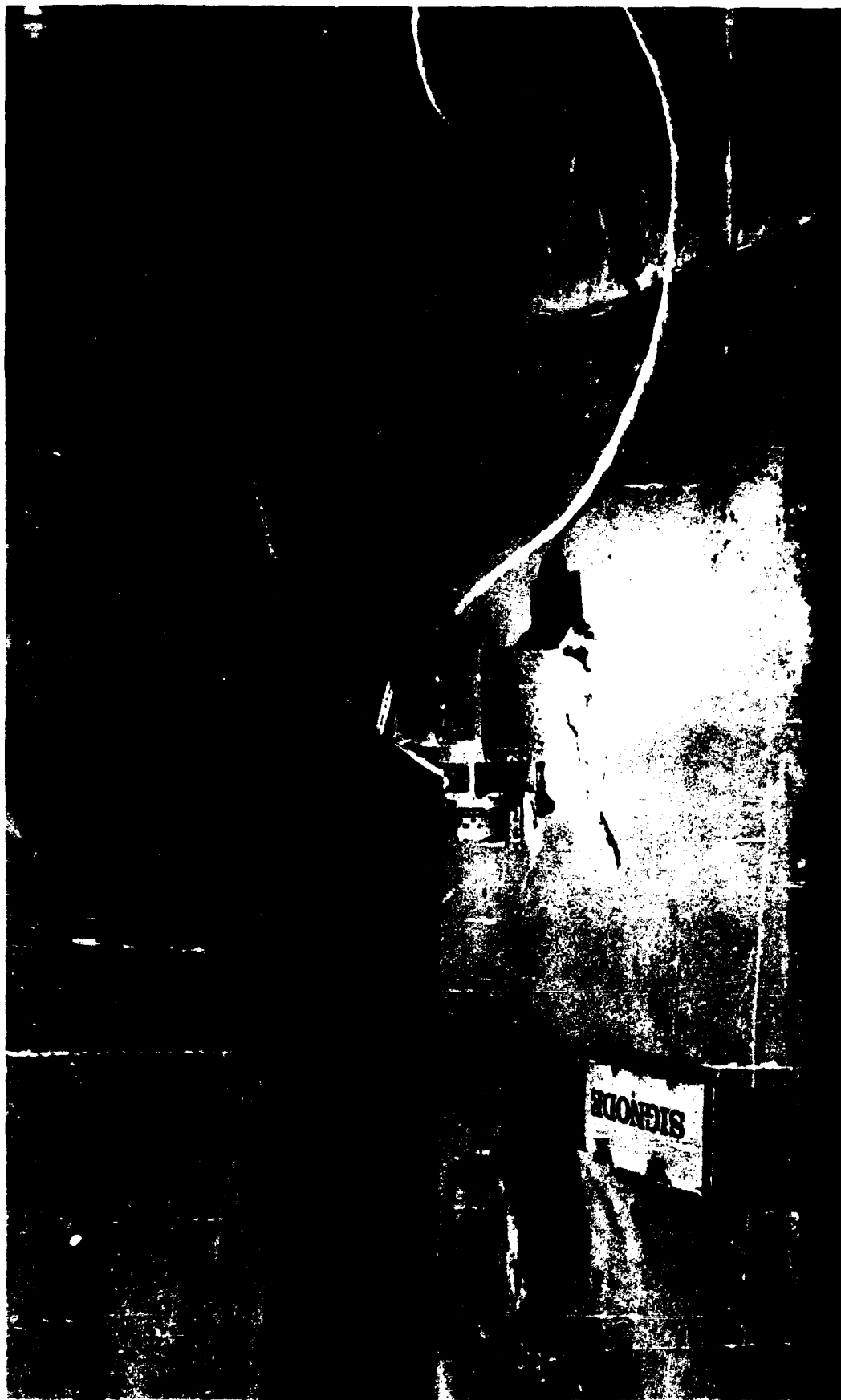
View of two arms with two steel plates strapped with banding. Wooden pad also shown under steel plates on Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 5

View of rub blocks used to protect hydraulic lines on Recovery Assembly.



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Photo No. 6

View of accelerometer mounted on barrier support beam of Recovery Assembly.



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Photo No. 7

View of accelerometer mounted on front transport of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 8

View of accelerometer mounted on pallet base of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 9

View of accelerometer mounted on camera platform of the Recovery Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 10

View of accelerometer mounted on floor of railroad flatcar.

STATIC PULL TESTS

SYNOPSIS OF TESTS

At the request of MTMC, static pull tests were administered to the slinging and tiedown provisions of the Launch Assembly and Recovery Assembly to satisfy MIL-STD-209F.

During static pull testing of the tiedown provisions on the Launch Assembly, a forward longitudinal pull of 22,550 pounds was administered to the tiedown fitting. The tiedown fitting had no reinforcing plate to prevent the attachment bolt from pulling thru the pallet side wall. Later, MTMC revised the forward longitudinal pull requirement from 22,550 pounds to 5,638 pounds, which was accomplished without incident. The remaining tiedown provisions and slinging fittings on the Launch Assembly were pulled to the forces specified without failure.

All slinging and tiedown provisions on the Recovery Assembly were pull tested and no deficiencies noted.

STATIC PULL TEST

RECOVERY ASSEMBLY

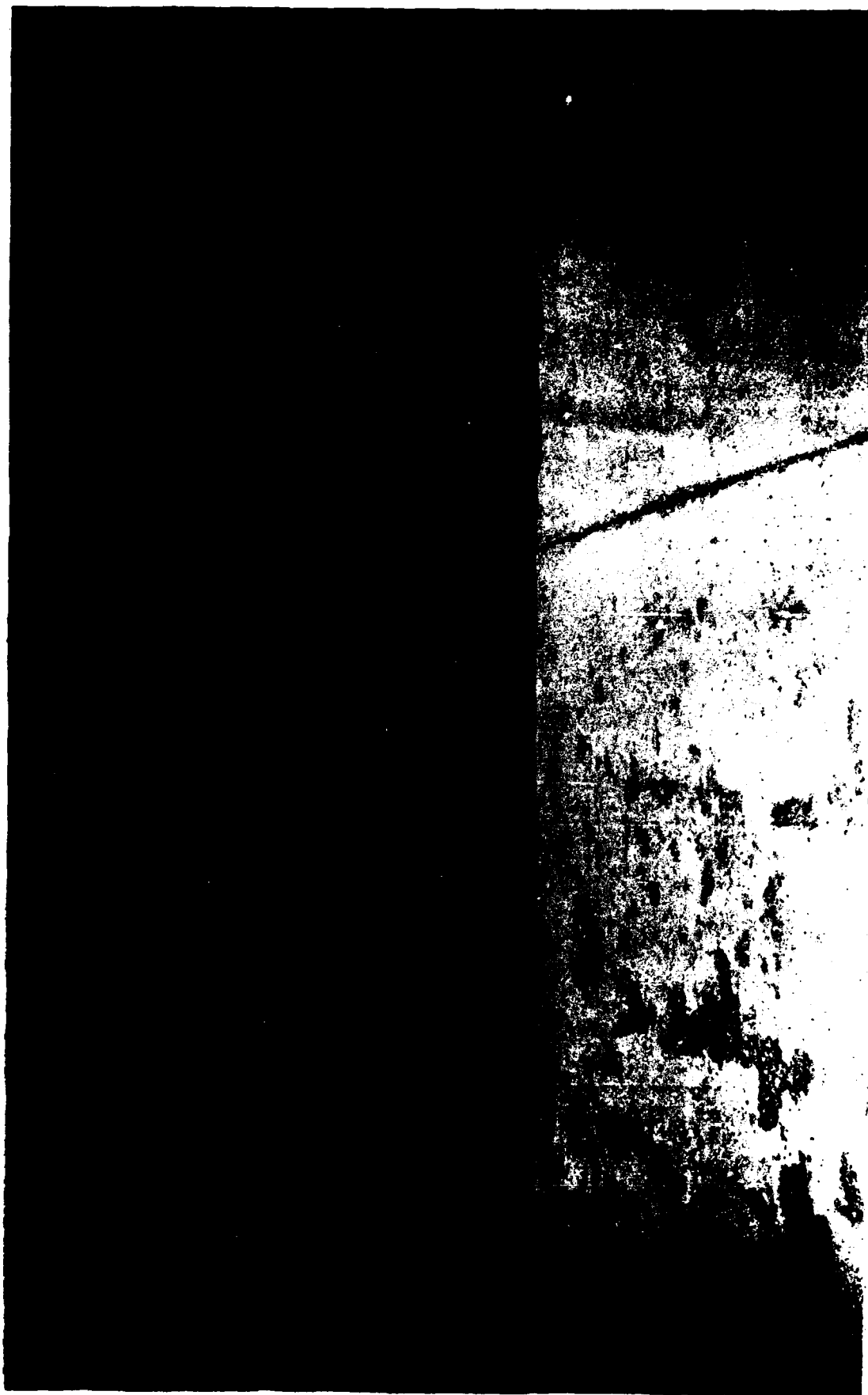
<u>LOCATION</u>	<u>DIRECTION</u>	<u>PULL (POUNDS)</u>	<u>DURATION (SECONDS)</u>
Lift Points	45 degrees	23.213	90
Lift Points	Forward	11.521	6 - 10
Lift Points	Rearward	9.600	6 - 10
Lift Points	Lateral	10.800	6 - 10
Lift Points	Lateral	7.254	6 - 10
Tiedown Points	Longitudinal	11.521	6 - 10

STATIC PULL TEST

LAUNCH ASSEMBLY

<u>LOCATION</u>	<u>DIRECTION</u>	<u>PULL (LBS)</u>	<u>DURATION (SECONDS)</u>
Slinging Provisions (each of four fittings)	45 degrees	12,800	95
Slinging Provisions (each of four fittings)	Longitudinal (fore and aft)	5,638*	10
Slinging Provisions (each of four fittings)	Lateral	4,228	10
Slinging Provisions (each of four fittings)	Downward	5,638	10
Tiedown Provision (each of four fittings)	45 degrees	12,756	95
Tiedown Provision (each of four fittings)	Longitudinal	5,638	10
Tiedown Provision (each of four fittings)	Lateral	4,228	10
Tiedown Provision (each of four fittings)	Downward	2,819	10

*Revised pull to 5,638 pounds after failure at 22,550 pounds



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 1

View of slinging (top) and tiedown (bottom) provisions on the Launch Assembly.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 2

View of Launch Assembly tiedown fixture that failed during forward longitudinal static pull of 22,550 pounds.